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Gear manufacturer and hob maker alike must face certain problems of practical gear cutting to meet the increasing demand for worm drives. High efficiencies require that helix angles be kept within well defined limits entailing the use of multiple threaded worms. The author outlines the long experience of his company on this timely subject

Worm Gear Hobs

L. R. MAYO

Brown & Sharpe Manufacturing Company

IF WE go back even a comparatively few years, we find that the tooth shape of a worm thread was usually defined as 29 deg. included angle on the axial section. The use of a straight-sided tooth shape on this section was a natural result of the fact that chasing in a lathe was the almost universal method of production. The selection of the 29 deg. angle naturally followed from the fact that this angle was the established standard for nearly all types of gearing.

Because of changing methods of worm thread cutting and increasing use of multiple threaded worms, many of which introduce manufacturing difficulties in both the worm and in the corresponding hob if the 29 deg. angle is retained, this tooth shape has been largely superseded.

A.G.M.A. recommended practice indicates the cutting of single and double threaded worms with a 29 deg. thread milling cutter and three and four thread worms with a cutter of 40 deg. included angle. This leaves worms having a larger number of threads without specific recommendations, and consequently, the rule for the selection of the cutter angle, which has been in use for some years and which covers all possible cases, may be of interest:

When the angle of thread with axis is 78 deg. or more, use 29-deg. cutters.

When the angle of thread with axis is 70 to 78 deg., use 40-deg. cutters.

When angle of thread with axis is 65 to 70 deg., use 45-deg. cutters.

When angle of thread with axis is 65 deg. or less use 50-deg. cutters.

Worms mating with wheels of 24 teeth or less should be finished with a cutter of 40 deg. or more included angle to avoid undercutting the wheel.

If the angle of worm thread with the axis is 72 deg. or more, make tooth depth equal 0.6866 × axial pitch. If less that 72 deg., make tooth depth equal 0.6866 × normal circular pitch.

It is well known that when cutting a worm thread, a rotary cutter does not reproduce its own shape. The use of an included angle cutter having straight cutting edges results in the worm threads being formed by a convex curve. The amount of this departure varies greatly, being practically negligible on the ordinary single thread worm but becoming a serious consideration on the high multiples.

It may be of interest to note that the diameter of the cutter has an influence on the resulting thread shape; the difference between the cutter shape and the resulting space increasing with the cutter diameter. Consequently, the hob maker should know the approximate diameter of the cutter to be used in the manufacture of the worm.

In this connection, it might be observed that a worm milled with a straight-sided included angle cutter is an approximation of an involute shape, this approximation being decreased as the cutter diameter increases. If the cutter were of infinite size, a true involute shape would result.

The statement is frequently heard that the difference between the cutter shape and the shape of the resulting worm "varies with the helix angle"; that is not strictly

Presented at the sixteenth annual meeting, American Gear Manufacturers' Association, Cleveland, Ohio.

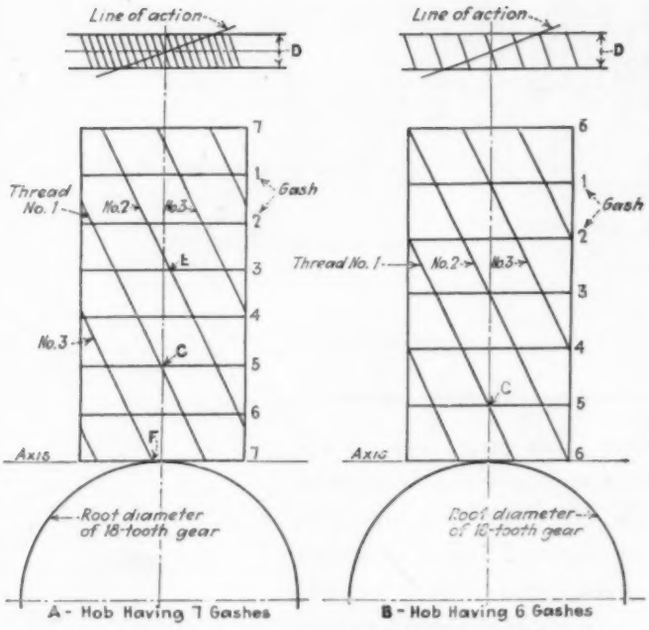


Fig. 1—In selecting the number of hob gashes, a choice must be made between accurate tooth spacing and the avoidance of flats. One solution is "stepping" with no exact ratio of gashes and threads

correct, which is evident when we consider that a worm of infinite diameter becomes a helical rack, in the cutting of which no cutter distortion can take place, even though the helix angle be large. It is believed to be more accurate to say that the worm's departure from the cutter shape varies with the difference between the helix angles found at the worm root diameter and outside diameter.

If the worm is known to be convex, what should be done about the hob tooth shape? Many would say that the hob should be like the worm; this, if strictly carried out, would mean that a formed tool rather than one made to straight lines would be required for all hobs when the corresponding worm was produced by a straight-sided milling cutter. It has been demonstrated in practice that many hobs can be satisfactorily made with straight tooth shapes; in fact, the nature of this approximation is fortunately such as to ease off the tooth contact near the top and bottom of the worm gear tooth. Up to a certain point, this is perhaps an advantage as it avoids interference and tends toward easy engagement. If carried too far, the amount of contact would be seriously reduced. In such cases, the hob tool is fitted to a dummy or master worm. The rules used to determine when the tool shall be fitted to a dummy are:

Fit hob tool to dummy worm when:

(a) Angle of thread with axis is less than 78 deg., or

(b) When the difference between the helix angles at the worm outside diameter and root diameter exceeds 5 deg.

In the design of worm gears, the ratio existing between the worm and gear is, at times, fixed. Frequently, however, an exact ratio is not required, and in such a case, the question arises as to which is more desirable—an even or a prime ratio. It is contended by some that even ratios are best because any given wheel tooth is then acted upon by only one thread of the worm and that, consequently, it soon conforms to the individual tooth shape and index peculiarities of that thread. This reasoning seems logical, but so far as the author is aware, no real investigation of the subject has ever been made.

Using a modern worm having hardened and ground threads, it is possible that the even ratio might not show measurable advantages. From the standpoint of the gear manufacturer, however, the prime or hunting ratio is preferable as it automatically produces uniform gear teeth, regardless of the hob's design or condition.

In the case of an even ratio, a repeating error is difficult to avoid. This error is conveniently measured by means of a ball-point indicator applied to the gear spaces and contacting at approximately the pitch line. What is usually found is that the readings will repeat, the number of readings in each cycle being equal to the number of threads in the hob or worm.

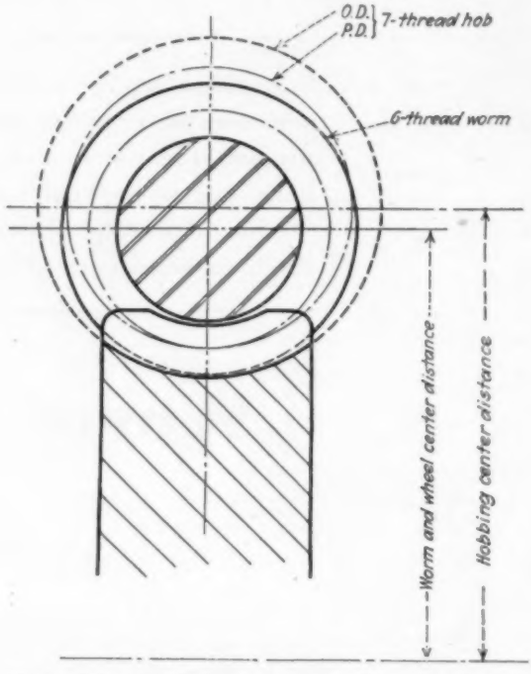


Fig. 2—Uniformity in the teeth of even ratio worm gears may be obtained by making the hob with one tooth more than the worm

Excluding tangential feed hobs for the present, it can be readily shown that these repeating errors are to be expected—

(a) If the hob contains any errors of either manufacture, sharpening or mounting.

(b) If the number of gashes are not exactly divisible by the number of threads.

The reason for this last statement is illustrated by Fig. 1 at *A* which shows in diagrammatic form a development of a hob having three threads and seven gashes. Straight gashes have been used to simplify the illustration.

It will be noted that the tooth *C* is the only one in the whole hob which is on center with respect to the gear being cut. Also, that in threads Nos. 2 and 3, the teeth marked *E* and *F* are nearest to this center line. By calculation, their distance is found to be 0.143 for the case in question, and further calculations show that when tooth *C* reaches the root diameter of the gear, teeth *E* and *F* will be 0.0041 away.

B in Fig. 1 is like *A* in every way except that the number of gashes has been reduced to six. Under this condition, we find that the disposition of the teeth in

each thread is identical; in other words, if a tooth in one thread is centered with the gear, a tooth in each of the other threads will also be centered. Theoretically, the use of such a hob made without errors and perfectly mounted will produce uniform spaces in the gear being cut even though the ratio between hob and gear is even.

At the top of both of these diagrams, all of the cutting teeth have been projected and are shown in relation to an assumed line of action. It will be noted that in Diagram *A* there are 14 teeth within the line of action but only four in Diagram *B*. This, of course, is because the hob at *B* contains three sets of duplicate teeth.

From the foregoing, it appears that, while making the number of gashes exactly divisible by the number of threads has resulted in uniformity of wheel teeth, the number of generating positions is small. This produces flats on the teeth which are frequently objectionable, particularly on coarse pitches and low numbers of teeth.

A method of overcoming this is sometimes referred to as "stepping"; that is, causing each thread of the hob to pass through each space in the wheel by successively feeding to depth, withdrawing, and indexing the wheel one tooth and again going to depth. The hob in this case should be made as illustrated at *A*—the number of threads and the number of gashes having no common factor. "Stepping," of course, takes some additional time and may require a better type of machine operator. It is, therefore, not suggested as a regular manufacturing procedure, but rather, as a means of improving the quality of the occasional job which may be giving trouble.

In our original example, a ratio of 3 to 18 was assumed. If, instead of 18 teeth, the gear had 17 or 19 teeth, then a hob made like *A* would be decidedly preferable because of the larger number of effective generating teeth. From these considerations the following rules, governing the selection of the number of gashes in multiple thread worm gear hobs, have been derived:

1. If the number of threads in the worm and the number of teeth in the wheel have no common factor, then the same condition should prevail between the number of threads in the hob and the number of gashes.
2. When the worm and gear have a common factor, or when the hob is to be used for general-purpose work, the number of gashes should be exactly divisible by the number of threads. An exception would be made if it were known that a hob user was willing to "step" his even ratios.

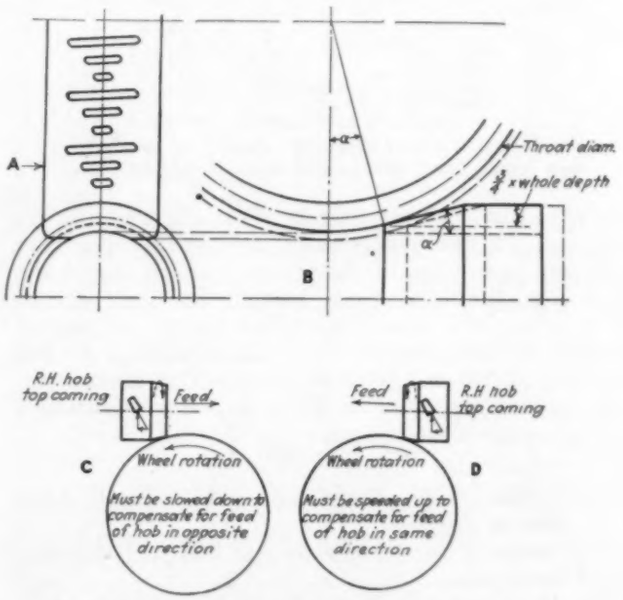


Fig. 3—For tangential feeding, the hob taper should be normal to the throat diameter of the blank and three-quarters of the tooth depth

It has at times been found that a gear manufacturer, cutting an even ratio with a hob similar to that illustrated at *A*, can greatly reduce his difficulties by adding or subtracting one tooth from the gear. This, of course, is not always permissible, but when it is, the resulting improvement is frequently great. To do this, no changes in center distance or worm gear blank dimensions are required. Whether a tooth should be added or subtracted will depend upon the individual requirements of the job. It should be remembered, however, that if an additional tooth is put in a gear having a low number of teeth, or one whose pressure angle is low, an objectionable amount of undercut may result.

An effective method of getting uniformity in the teeth of even ratio worm gears is to add a thread to the hob. For example: If the worm had six threads and the gear 120 teeth, the hob would be made with seven threads. The pitch diameter and lead of the hob would be proportionately increased, thus retaining the original helix angle.

It is true that this results in a somewhat decreased initial contact between the worm and gear, but when the worm has five or more threads, the addition of one more in the hob is frequently not objectionable. Fig. 2 shows such a case; the proportions being those of a six-threaded worm and a seven-threaded hob. Any suitable number of gashes could be used in this hob except seven or a multiple of seven.

If a regular or radial feed worm gear hob could have an infinite number of cutting teeth, it would be theoretically possible to secure perfect initial contact between the worm and gear. Obviously, this is not possible but this condition is approximated by the use of a taper or tangential feed hob. While such hobs have about the same number of gashes as the regular type, the relatively slow tangential feed motion causes each cutting edge to assume many positions as compared with the one which it would maintain in a radial feed hob.

The use of the tangential feed method is particularly beneficial when cutting even ratios as it does away with having to choose between "stepping" on the one hand and coarse generating flats on the other. To secure the full advantage of tangential hobs, they should be made with ground teeth. This is particularly desirable when cutting even ratios.

The number of gashes in a tangential hob are not important if an even ratio is being cut. If, however, the number of gashes is not exactly divisible by the number of threads, the various threads of the hob will begin cutting progressively, instead of simultaneously; the appearance of the gear being somewhat as illustrated at *A* in Fig. 3.

If the ratio is not even, the number of gashes should be exactly divisible by the number of threads; otherwise, one hob thread will remove more than its share of the stock from the gear and thus greatly decrease the rate of feed which could be used successfully. It is, therefore, the general practice to make the number of gashes

of all tangential hobs exactly divisible by the number of threads. An exception would be made to this in a case where the hob was to cut an even ratio only if this were necessary to produce a well proportioned length of hob tooth.

At *B* in Fig. 3, the method ordinarily employed in establishing the angle of taper is illustrated. If various sized gears were to be cut with the same hob, the largest of these would be considered in establishing this angle. It will be noted that the amount of taper equals three-quarters of the tooth depth and that the taper is established tangent to the throat circle.

At *C* and *D*, two methods of tapering are illustrated; the hobs being identical except that the taper is applied at opposite ends. It is believed that the type of taper illustrated at *C* is used more frequently. No attempt is made to say which type is preferable, although an analysis of the thrust and backlash conditions show that there is a tendency for hob *D* to jump forward to the extent of the backlash between the hob slide screw and nut.

On the other hand, the action of the differential when using hob *C* is required to slow down the index rotation of the gear being cut. This condition appears to introduce the possibility of backlash. It is felt that the experience of users who may have used both types of tapers may determine conclusively which is to be preferred.

The length of the parallel section of a tangential hob seems to be debatable. Theoretically, a single finishing tooth in each thread is sufficient. From a standpoint of actual practice, it is felt to be safer to increase this number. A minimum of three teeth in each thread has been established as regular practice. Instances have been encountered, however, where a user insisted on a much longer parallel section for one or both of two reasons: First, so that he may use the hob with either radial or tangential feed, and secondly, because of the contention that when using tangential feed there should be sufficient full teeth to insure complete generating action after the machine is relieved of the strains set up by the roughing teeth. Such procedure may result in an improved product, but the cutting time is naturally increased. It is felt that a hob user wishing a hob of this description should clearly indicate his requirements when ordering the hob.

Most worm gears are manufactured on an interchangeable basis; that is, a standard center distance must be maintained, and in addition, any worm must run satisfactorily with any gear. Another usual requirement is that an angle of 90 deg. between the axes of the gears be adhered to. As the teeth of a hob must be relieved or backed off, it follows that a new hob must be made oversize in diameter in order that it may give reasonable service before being discarded because of a reduced diameter.

Finishing hobs for unusually important work, such as index wheels, are usually made with a very small allowance for sharpening, the amount which the diameter is made oversize on the new hob frequently being as little as 0.005 to 0.020, depending upon the pitch. For regular commercial work, such small allowances would decrease the hob life to a degree that would be prohibitive; consequently, larger sharpening allowances are generally used.

For many years this allowance has been based on one factor only; namely, the axial pitch of the hob. Experience has shown that under this condition, single-thread

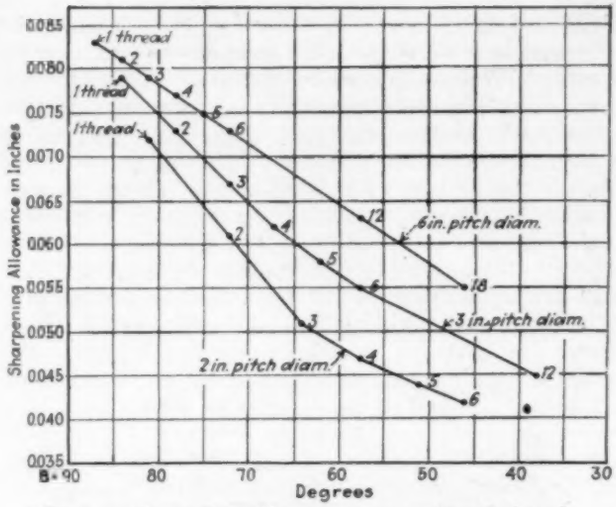
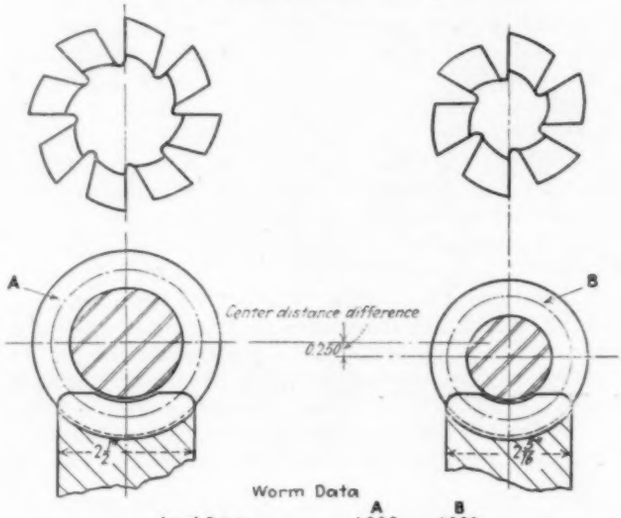


Fig. 4—Sharpening allowances on various hobs of 1-in. axial pitch are compared graphically
Tooth depth = 0.6866 × axial pitch when *B* = 72 deg. or more
Tooth depth = 0.6866 × normal circular pitch when *B* is less than 72 deg.



Worm Data

	A	B
Axial Pitch	1.000	1.000
No. of Threads	4	4
Pitch Diam	2.750	2.250
Outside Diam	3.487	2.987
Angle of Thread with Axis	65°9'	60°30'
Theor. Eff (Coef. of Friction Assumed as 0.05)	88.17%	89.28%

Fig. 5—Small worm diameters should be avoided; they impair tooth contact and increase cutting costs

hobs would have an unnecessary short life while, at the same time, a multiple-threaded hob would give poor tooth contact because of the presence of the sharpening allowance. Consequently, a formula has been written which takes into consideration the factors of normal circular pitch and also the helix angles found at the hob outside diameter and pitch diameter. This formula is:

$$\text{Sharpening allowance} = 0.075 \times \text{Normal Circular Pitch} \times \left[\frac{16 - (A\text{-}B)}{16} + 0.010\right]$$

A = Angle of thread with axis at hob outside diameter in degrees.

B = Angle of thread with axis at hob pitch diameter in degrees.

The characteristics of the sharpening allowance calculated by means of this formula may be summarized as follows:

For a given axial pitch, the influence which "normal circular pitch" in the formula has on the 0.075 constant will vary from approximately 1 to 0.7.

Within the range of practical hobs, the value of $\left[\frac{16 - (A\text{-}B)}{16}\right]$ will run from 1 to 0.5.

Thus, two hobs of the same axial pitch may, in an extreme case, have sharpening allowances varying as much as 3 to 1. The one receiving the smaller allowance will be of much smaller normal circular pitch and will be of small diameter relative to its pitch, resulting in a hob which would not give satisfactory tooth contact if made with a large sharpening allowance.

The last item of the formula (+0.010) is designed to prevent the allowance on fine pitch hobs from becoming unreasonably small. For example: Without this factor, a hob of 0.100 axial pitch would, neglecting the helix angle, receive an allowance of only 0.0075, while with it, this becomes 0.0175. The chart in Fig. 4 shows graphically the sharpening allowances resulting from the use of the formula as applied to a considerable number of hobs, all of which are of 1 in. axial pitch.

If a gear is cut with a hob that is oversize in diameter, the resulting contact on the gear teeth will be on diagonally opposite corners. To avoid this, it is common practice to adjust the hob axis slightly from the 90-deg. relation with the axis of the work spindle. The amount of this adjustment depends upon the difference between the angle which the worm thread makes with its axis as compared with the similar angle of the oversize hob. In each case, this angle is calculated at the pitch line, the pitch line of the hob being considered to have been expanded as much as its outside diameter is oversize.

In measuring the diameter of a hob to determine the amount which it is oversize, it should be remembered that the hob tooth is made to provide a clearance between the outside diameter of the worm and the bottom of the gear tooth. To take a specific example: If a 1-in. axial pitch worm had an outside diameter of 3 in., the corresponding hob would (using standard tooth depth based on the axial rather than on the normal circular pitch) have an outside diameter of 3.100 if no sharpening allowance existed. The amount by which the hob outside diameter might exceed this figure would be the amount to add to the worm pitch diameter when calculating the angle of the hob teeth with their axis as referred to above.

It should perhaps be stated that setting the hob spindle in accordance with the calculation referred to cannot be depended upon to give the best possible contact between the gear teeth. The calculated angle, however, gives a good approximation, but for the best results, a further slight adjustment as dictated by an inspection of the first gear cut is frequently desirable. The need of this second adjustment usually increases with the number of threads in the hob.

A method of avoiding the complications resulting from the use of a sharpening allowance, which is sometimes practiced, is to make the worm diameter to correspond with the existing hob diameter. This, of course, results in non-interchangeable worms and gears, although it is possible to retain a standard center distance. The advantages of this practice are that the hob life is materially increased and that the hob spindle can remain set at an angle of 90 deg. with the work spindle at all times.

A recommended standard for the diameter of worms, made with a bore in keeping with the pitch, has been adopted by the A.G.M.A. It is believed that a similar standard could profitably be devised for those worms which are made as a part of the shaft. It is felt that quite frequently gear manufacturers have, when all factors are considered, adopted undesirably small worm diameters. This tendency has presumably been caused by a desire to obtain high efficiency. Fig. 5 shows two worm and gear sections with their corresponding hobs which illustrate the point in question. The diameter of worm *A* was determined by the formula which appears in the current edition of the Brown & Sharpe "Formulas in Gearing" which reads:

Pitch diameter = (2.35 × axial pitch) + 0.4.

Worm *B* is the same as *A* except that its pitch diameter has been reduced $\frac{1}{2}$ in. The disadvantages of Design *B* as compared with *A* include:

1. Hob is much weaker and has fewer generating teeth.
2. Hob cost per gear will probably be much higher.
3. Hobbing time per gear will be greater because of hob weakness.
4. Good initial tooth contact will be more difficult to attain.
5. The maximum width of face of the mating gear is less thus reducing the maximum load carrying capacity.

It is, of course, true that the center distance when using worm *A* is increased $\frac{1}{4}$ in.; also, that the efficiency calculated on the basis of a coefficient of friction of 0.05 is reduced approximately 1 per cent. It is felt, however, that these points are relatively unimportant when compared with the unavoidable disadvantages of extreme small worm diameters, and that though general adoption of a formula, such as that suggested, would work to the mutual advantage of both the gear manufacturer and the maker of the necessary cutting tools.

• NEXT WEEK •

Non-repetitive manufacture has long been the hoodoo of production control. But the difficulties of management for a diversified product have been successfully met by the Worthington Pump Company. Chester B. Lord describes the philosophy as well as the practical workings of this plan.

Some weeks back we published an article "Deflating the Patent Budget." Now Lawrence Langner comes forward to defend the patent and tells what it has done for American industry.

"Pin Inspection of Tooth Profiles" by Sam Trimbath shows that irregularities in tooth-form besides eccentricity can be detected by this method. Heat-treating is not always appreciated especially by those who live in our penal institutions. The fabrication and heat-treatment of laminated plates and bars for prison cells is pictured and described.

• IN A. M. •

Arc Cutting of Metals

Fig. 1—This type of carbon electrode holder and asbestos clothing used by an operator when cutting with the carbon arc are necessary because of the heats generated

Arc welding has long since become a standard operation, but its companion process, arc cutting, has been introduced in few shops, though it has some definite advantages. Here are given information for its use, some applications, and an indication of its place in the metal-working industry

ARC CUTTING, while not a new process, has recently been revived by increased use of arc welding in certain shops. It has found its greatest use thus far in railroad repair shops, where it is used in cutting down cars, cutting out rivets, and in similar scrapping and repair jobs.

Arc cutting is purely a melting process, the heat energy of the arc being used to melt the metal along the line of the cut. Direct current is used almost exclusively. Graphite or carbon electrodes are usually employed, preferably graphite because of their longer life which balances their higher first cost. Bare metallic electrodes may be used by operating at a higher current value than that necessary for welding, but this is not as economical. The British Admiralty has been using a modification of this method for cutting deep, small-diameter holes in armor plate by wrapping the metallic electrode heavily with asbestos yarn and dipping it in water. The water forms steam in the arc, blowing the molten metal away. This method also takes a higher current value, consequently is expensive.

Manipulation of the cutting arc is exceedingly simple, the operator merely advancing the arc terminal over the section to be cut at a rate equal to that at which the molten metal flows from the cut. The cutting speed increases with the value of arc current used. The width of the cut increases with the arc diameter and therefore as the square root of the arc current. Before cutting the plate the welder must outline the desired course by a series of prick punch marks or with white lumber crayon, the punch indentation or crayon mark being plainly visible in the light radiated from the arc. When cutting deeper than 4 in., the electrode should not come in contact with the walls of the cut and thereby short-circuit the arc.

For general cutting work with carbon or graphite electrodes, a current value of 300 to 1,000 amp. is required, depending upon the material and the cutting speed desired. This can be used for cutting off risers and burrs in foundries, scrapping and rebuilding freight cars, cutting out rivets, and a variety of similar work. Cutting with the arc is not limited to iron and steel, but

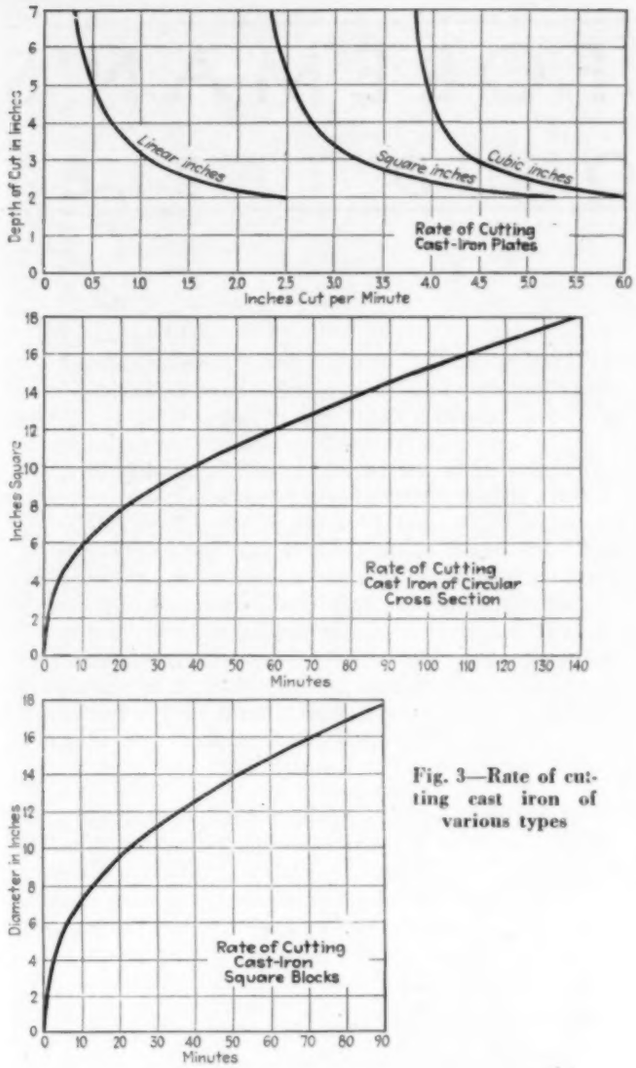


Fig. 3—Rate of cutting cast iron of various types

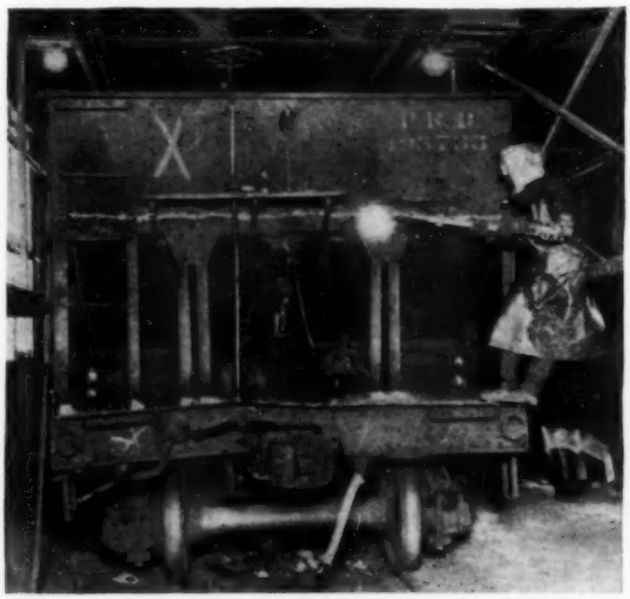


Fig. 2—An operator in a railroad shop uses the carbon arc for cutting up a coal car into small enough sections to be charged into the cupola

can be applied equally well to non-ferrous metals such as brass, bronze and copper. It has been found especially economical for cutting copper. Copper has a high thermal capacity and high heat conductivity and, therefore, dissipates heat rapidly. For this reason, it is necessary to use a high current (800 to 1,000 amp.) in order to melt the copper before the heat is dissipated. In a test by Westinghouse Electric and Mfg. Company, a large piece of copper slag, 6½ ft. wide by 7 ft. long and an average of 4¼ in. thick, was cut at a rate of 3½ ft. per hr. The current value was 1,000 amp. and the cost, on the basis of labor at 60 cents an hour and electric power at 3 cents a kw.-hr., was $16.78 for a 5-hour job.

A 3x9-in. gray iron casting riser was cut in 5 min., using 800 amp. The main portion of the riser, measuring 8x8 in., was then cut through in 17 min., using the same current. This gives a cost, on the previous basis, of 15 cents for cutting the neck and 52 cents for cutting the body of the riser. The speed of cutting cast iron in several forms, using 600 amp., is shown in accompanying charts.

Cuts in ½-in. ship steel plate yielded these results: A cut ½ in. wide by 8 in. long was cut with 250 amp. in 2½ min., while a cut 0.8 in. wide by 8 in. long with 650 amp. was cut in 1 min.

In scrapping and rebuilding freight cars, the plate material may be cut into pieces small enough to be charged directly into the cupola, or into larger pieces to be recut by a shear. This material is usually heavily covered with paint and rust so that current values of 400 to 600 amp. are frequently used, and as much as 800 amp. has been necessary. In four hours, an entire coal car can be cut into pieces small enough to be handled by four men for recutting in a shear. This can be done at a rate of 75 ft. per hr., using 800 amp., the total cost including labor and power being $6.80.

Rivet cutting requires a current of 400 to 600 amp., and average operators will cut 1,800 to 2,000 ⅝-in. rivets per ten-hour day, using 400 amp. A skilled operator can cut as many as 2,600 to 3,100.

The Temple Gun—*Discussion*

BY C. G. WILLIAMS

THE delayed action principle used in the Temple gun is not new. It is but an adaptation of the old bolt gun used in railroad shops to blow bolts out of a locomotive frame.

Bolts in locomotive frames have a taper of $\frac{1}{16}$ in. to the foot, and a well made bolt fitted to a well reamed hole with ⅝-in. drive will almost weld itself to the surrounding metal as far as loosening its grip is concerned. If, as is often the case, this bolt is from 36 to 42 in. long, one can imagine the effort required to dislodge it. However, a small charge of powder below a plunger, with or without the delayed principle, will drive one of these bolts not only out of the frame, but at times, out of the shop.

The delay principle was explained to the writer in 1896 when he inquired the "why" of a hardened pin through the top of the gun and the center of the plunger. The old machinist said: "If the bolt seems to be too tight to move with a loose plunger, I put the pin through and set it with about an inch between the plunger and the bolt. It always works then."

The FOREMAN'S ROUND TABLE

Merry-Go-Round

"SO I came right back with the remark that with many wives it's polygamy, with one it's monotony. And right away he walked off in a huff, Ed!"

"Smart boy, Al? But hold on a minute—there's a point, that monotony business. We were talking that over a while ago—you know—about making men's jobs less monotonous. You probably promptly forgot it, but I've been thinking it over, and I think I've got a solution."

"Is that so, Einstein! Just what may it be?"

"Why not change the men around; give 'em different jobs every so often? It is foolish to put an intelligent human being on a little two-by-four job and to leave him there until he grows gray or goes to the bughouse. That idea was worked up by personnel directors so that they could make their jobs look essential. It's all wrong from every point of view, I tell you." Ed was punctuating his remarks by pounding the cafeteria table till the dishes rattled.

"Hold on, Ed, don't get excited. You figure that changing wives and changing jobs both have their merits. But did you ever think that no good man will stay on a two-by-four job until he grows gray? If he sees that happening, he'll step out and get a new job. But I'll admit there are a lot of men who, when dissatisfied, will just growl and hang on. How can that trouble be cured?"

"Cure it? I'd classify all my jobs. Those that had sufficient variety I'd call permanent. Others that were hard to learn and would keep a man interested in learning them, I'd call special. Still others I would classify as quarterly and monthly jobs."

"In effect you would be breaking in men all the time, and about the time they became proficient in one job, you'd transfer them to another. That your idea?"

"Maybe, but I'd at least have them contented and after they had all changed around once they'd all be on to their jobs."

"Yeah? But the output would be mighty low. I don't think the idea would work."

"You would think that, but I don't. In the long run, we'd have better men, and the average output would be greater. Every man would try to beat the record of the man that had the job before he did. Don't every man make better time every time you change a job? Well, that's what would happen. Every man would find a better way of doing things, do them quicker, and then pass the method on to his successor."

"Yeah, the old do-more-work-in-less-time gag, what?"

"Well, there's a lot of truth in it. A man can always work better when he's content. That was your own argument. Or did it only apply to such superior beings as foremen and other executives?"

"No, Ed, your contention is sound, but I am in doubt about its practical application."

"I'm not worrying about either its theory or the practicability of its application. I'm worried, or would be if I was that kind of a duck, by the possibility of its application. There are people, you know, who want to see a profit before they will spend money. Just so there are executives who want to see a thing work before it's tried out. It can't be done."

"Well, Ed, I'm fairly radical, but I just wouldn't want to sponsor that idea. I would try it out, though, just to see how it works."

"I know it would suit everyone but the personnel department, and maybe they'll discover it as a new trend in human engineering. That's the way most new ideas originate. Some engineer sees them in some shop and gives it a high sounding scientific name. Other men read about it and then they become that kind of an engineer."

Has Ed's idea any elements of practicability? Would it help to vary the monotony of piecework?

Suggested by Glen Macomber

Discussions

Too Much Imagination

Years ago in high school I raised the question of the queerness of a situation wherein literally hundreds of men strove valiently to secure jobs as refuse collectors in my home city. To me, with a certain aversion to "mussy" work of any sort, it seemed incredible that work which appeared so highly unattractive, could be so much in demand.

An old friend of the family went a long way toward putting my youthful mind on the right track by remarking, "Well, son, as long as this world endures, I guess there will always be hewers of wood and drawers of water."

This added in my mind to a statement of principle, which twenty years of active production management has proved true, namely, that wholly aside from any technical ability or physical capacity, individual fitness for a particular task is a matter of temperament.

Just as a high-strung race horse lathers and generally exhausts himself in fruitless strivings and wasted nervous energy when attached to a work wagon, and a placid, broad-backed Percheron can work steadily all day on a plow, so the alert, exploring type of mentality finds drudgery in routine, where the ruminative type of being will find peace and happiness. —D. C. Wright.

Treasure Chests

I am convinced the reason suggestion boxes are not a greater success, is because of the prejudice shown by the foremen and engineering departments.

"What does that dumb-bell know?" is the usual comment on reading the suggestion submitted by a worker. I have in mind a drill press operator who had studied extensively through correspondence schools, and was of an inventive turn of mind. He was always making suggestions for more rapid production, which were always turned down. Finally, he was discharged, and his foreman confessed to me that he was sick of his continued suggestions. That same man has for seven years been one of the leading designers for an internationally known firm. His old firm had refused to take advantage of his inventive abilities for 60 cents an hour, and pooh-poohed his attempts to increase production.

There is always something that can be learned from the other fellow no matter how inferior his job or how uneducated he may be. The man who is daily handling the job must have a more intimate touch than the member of the engineering department sitting in his office.

It is necessary to look beyond the crude sketches, poor spelling and smudgy papers. Perhaps there may be fine ideas and money saving methods obscured by their illiterate conveyance. —Thomas Rosevear.

Overloaded

There are those whose ideas of industrial management is obtained from text books written by college professors. That is because the only books available have been written by college professors. That is why you have one of your characters ask the question, "What about paying men for loading machines?" The very question presupposes a case where that is all there is to the job—just loading. There are such machines, and there are such cases. I saw a man sitting in an armchair feeding cardboard to a paper box machine the other day. He was doing it automatically with a vacant look on his face and a mind that was far from the shop. He was paid for loading, thus proving that the proposition is no new thing. To be sure, the company thought it was paying him for inspecting the cardboard before he fed it into the machine, but that was where the company got fooled.

What our text book writers forget is that for every shop with ideal conditions, working on mass production with conveyors, automatic machinery and lines of men, each to do a certain thing, there are ten shops where the workman is still a real live, flesh and blood, thinking man who has to keep on thinking about the job after the machine is loaded. Machine tool shops may have a few jobs where the main thing is loading, but they are about as plenty as hens' teeth. Outside the machine tool shops the idea is old and is used wherever it is possible. For a hundred years the textile mills have had gangs of men to get looms loaded and running and another set of operatives to tie weavers knots when necessary. There is nothing new about the idea except the erroneous idea that it is universally applicable.—E. H. Fish.

Muzzling the Press

Should a man's opinions be at odds with those of his employer, he should take the subject up with some one who is in a position to do something about it. If for any reason this is not possible, it would be wiser not to broadcast his opinions. To criticise and discourse freely to people who cannot make the suggested changes is futile and ineffective.

Take for example the soap box orator, who rants and raves about economic conditions to a helpless and impotent audience. The very nature of his audience makes it impossible for him to get results, and therefore, his is not even considered dangerous by those whom he attacks most viciously.

Discussion and mutual expression of opinions among close friends is natural, and in most cases, helpful in clarifying the subject. However, constant criticism of an employer, freely expressed to any one who will listen, only hinders the management, and sooner or later will show up in a man's work, at which time he must suffer the consequences of his own folly. —John E. Orban.

Carelessness

For the habitually careless and inattentive, hardly any discipline is too severe, and the treatment outlined by Williams is not too harsh. Some men become rather "swell-headed" about their work, risking much, and unless taught caution, are of little worth.

The best and most vigilant are fallible, and it can truly be said that one who never makes a mistake never makes anything. To punish such people for occasional error or oversight is folly. Their self-consciousness makes them miserable enough. Forbearance and sympathy are more appropriate here.

We must discriminate between errors caused by inattention, and those caused by over-eagerness or hurry. One has known the most careful men to make slips in an endeavor to push work through on time. One has also known men in authority wise enough to overlook errors in such cases.

—Wm. Bryce, *Sheffield, England.*

Devices that Gage Work in the Machine

Interruption of operations is avoided by the German practice of applying precision measuring instruments directly to the machine tool

OLIVER P. VAN STEEWEN
Berlin, Germany

UNTIL comparatively recently, the measurement of work by means of gages or indicators, in the course of production, necessitated an interruption of the machining operation. Considerable cost was entailed by the frequent stops for measuring and by rejections caused by the lack of checking. In many cases, the accuracy of the machine tool was inadequate for attaining the close limits required in the finished product by adjustment of the feed. Accordingly, both from the standpoint of design and economy, the necessity arose for creating devices capable of automatically and continuously measuring the work during the machining operation. It will be readily understood that the first devices placed on the market did not meet all expectations, but in later developments a high degree of accuracy has been attained. Before entering into details of these developments, a general review of the subject is submitted.

It is well known that in the grinding of circular work the result is not always a truly round piece, the cause being small discrepancies in the bearings of the wheel spindle or the work spindle, poor balancing of the work and other rotating elements or negligence in chucking. These causes lead to the forming of polygons with curved sides of uniform diameter throughout as shown by Fig. 1. The illustrations are purposely exaggerated for the sake of demonstration. If work of this character is tested by measuring tools, the faces of which are at an angle of 180 deg., the size *d* is obtained, this value remaining uniform independent of the angle through which the work is turned. Deviations from the true cylinder will not show. In such a case, even measuring instruments of the indicating type, rigidly secured to the machine and using a single feeler point, will show but a slight movement of the hand on the scale, too trifling to furnish a clue as to whether the work is out of round or merely shows chatter marks. Therefore, this type of instrument is not suitable for furnishing reliable data regarding the size and shape of the work.

Even with instruments employing two measuring faces or points of contact the necessity arises of testing for the true cylindrical shape of the work with some suitable measuring tool. This subject of out of round shapes and multiple-point gages was thoroughly discussed in several articles in this magazine (*AM*—Vol. 75, pages 44, 173, 208).

At *D*, Fig 1, is a drawing of a pentagon with arched sides inspected with a straddle gage, the contact faces of which include an angle of 39 deg. The position of a piece of truly circular shape is indicated by the fine line. A change in the position of the work will take place if the work is pentagonal and is revolved within the gage. The lowest position, at *D*, Fig. 1, is marked by a heavy line and the highest position by a dotted line.

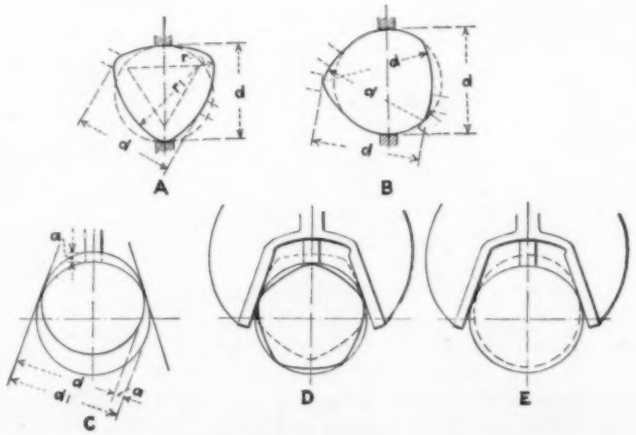


Fig. 1—Out-of-roundness is not always detected by a two-point gage. While a three-point gage is not infallible for certain geometric shapes, it reduces the likelihood of error

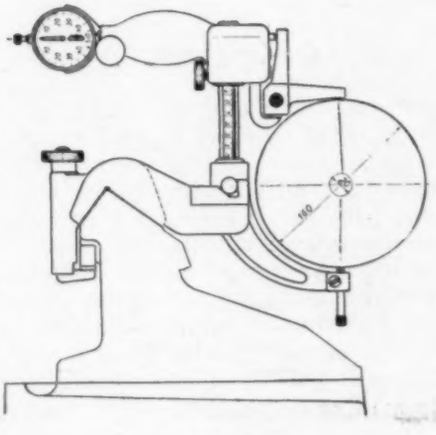


Fig. 2—This instrument is supported on a fulcrum so the movement of the index hand is not influenced by vibration in the machine

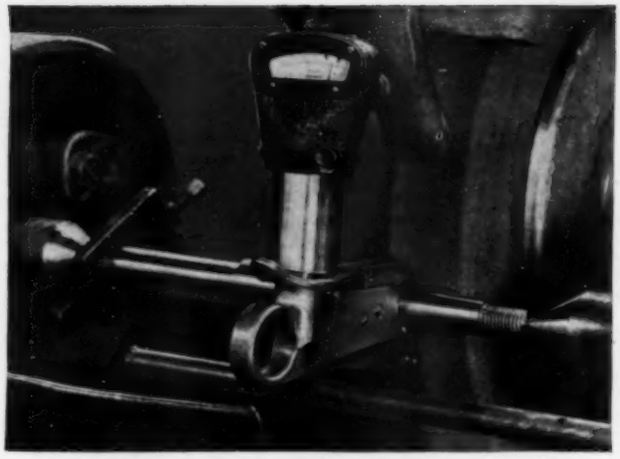


Fig. 3 — Particularly suitable for work of small diameter is this snap gage and microtast

These changes in position influence the feeler shown in the center of the gage. Now, while the movement of the index hand will not give the actual amount of the deviation, it will furnish proof that the work is out of round, although, if measured across any diameter, it will show uniformity in size. As only the deviation from the cylindrical shape is to be determined, the actual size of the deviation is unimportant.

The objection might be raised that not only triangles or polygons with curved sides, but also other undesirable shapes, as for instance, arched nine-cornered work may be turned out. These cannot be checked with a straddle gage with 39 deg. included angle of the legs, because in this case not crest to crest and face to face would bear against the sides of the gage but crest and face. The work, as it is revolved in the jaws of the gage, will in this case merely change its horizontal position. Since the position of the feeler is not altered by this movement, the work appears to be truly cylindrical, if the number of corners bears a certain relation to the angle of the straddle gage opening. However, since uniform polygons of the unfavorable relation to the angle of the gage are an exception which will be rarely or never met with, it is safe to say that the test for circular shape with a single straddle gage is reliable.

The automatic measuring devices used on different German machines may be described as follows:

Ludwig Loewe & Company apply to its hydraulic grinder, both with longitudinal feed motion and plunge cut, the automatic measuring device shown in Fig. 2. As this tool is suspended on a fulcrum, it will easily follow the continuous reduction of the diameter.

Fig. 3 shows a microtast snap gage made by Krupp, which is slipped over the work while the latter is being ground. It may be brought up close to the wheel and will stay on the work without being held by hand. Its measuring accuracy conforms to the graduation of the microtast instrument applied and is quite independent of the vibration of the machine. Fig. 4 shows a microtast gage used in the grinding of crankshafts.

Another measuring device for measuring outside diameters is shown in working position by Fig. 5. This instrument is likewise characterized by independence from the vibrations of the machine and is combined with a dial indicator. By its use, the measuring operation, which is automatic and independent of the sense of touch, may be watched until the correct size is obtained. While the feelers of the instruments are sensitive to the most minute vibration, the latter is never transferred to the index of the indicator. Vibration of the dial pointer thus plainly indicates irregularity in the grinding operation. The measurement is to plus or minus 0.00006 in.

The Grothkopp external measuring devices are made

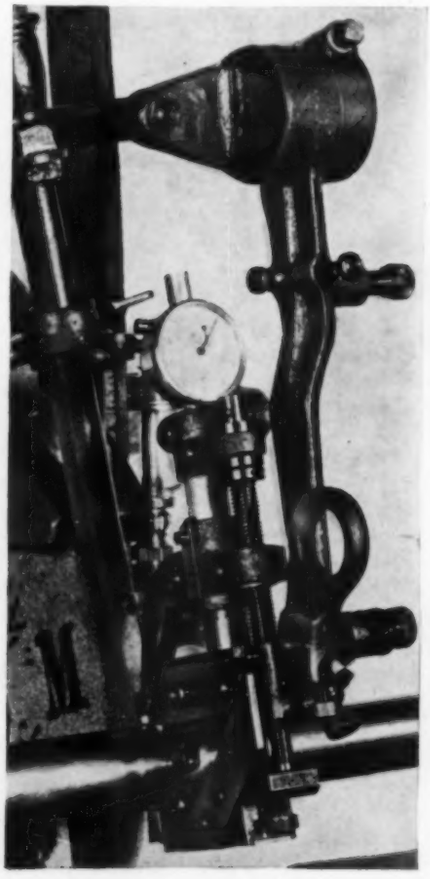
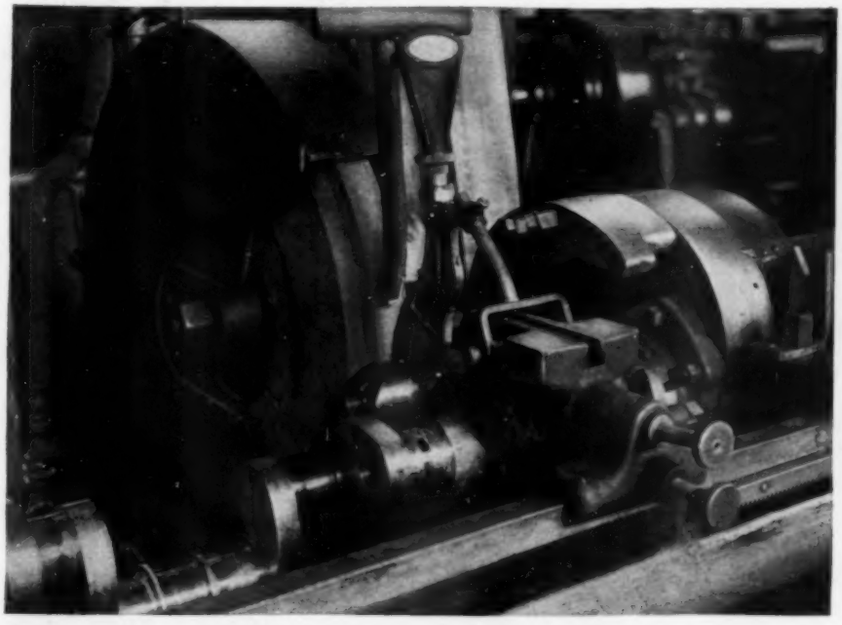


Fig. 5 — Correct sizing of outside diameters is obtained by observation of the dial indicator with the machine in operation



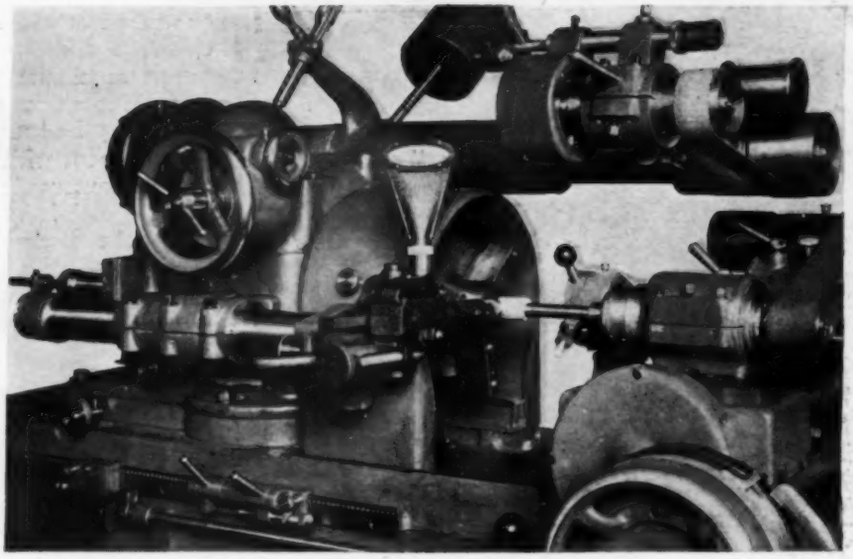


Fig. 6—Economical alike for small and large lots is this internal gaging device since it takes only 30 seconds to set up. Only a single measurement is required to adjust the index for a new job

throughout with three points to bear against the work. When the tool is applied to the work, during the grinding operation, it will automatically adjust itself square to the work and may be used both for plain pieces and work with keyways.

An inside measuring device is illustrated in Fig. 6. This tool is designed to line up parallel to the axis of the work spindle. The alignment is made with the aid of an accurate bushing. This internal measuring instrument is characterized by the possibility of measuring not only the finish size of the bore near the front face but also up to a depth of 110 mm. or $4\frac{5}{16}$ in. Like the gages for external work, it is capable of sliding over the keyways and other recesses. An exchange of the clamping sleeves makes the alternative application of a dial indicator or microtast possible.

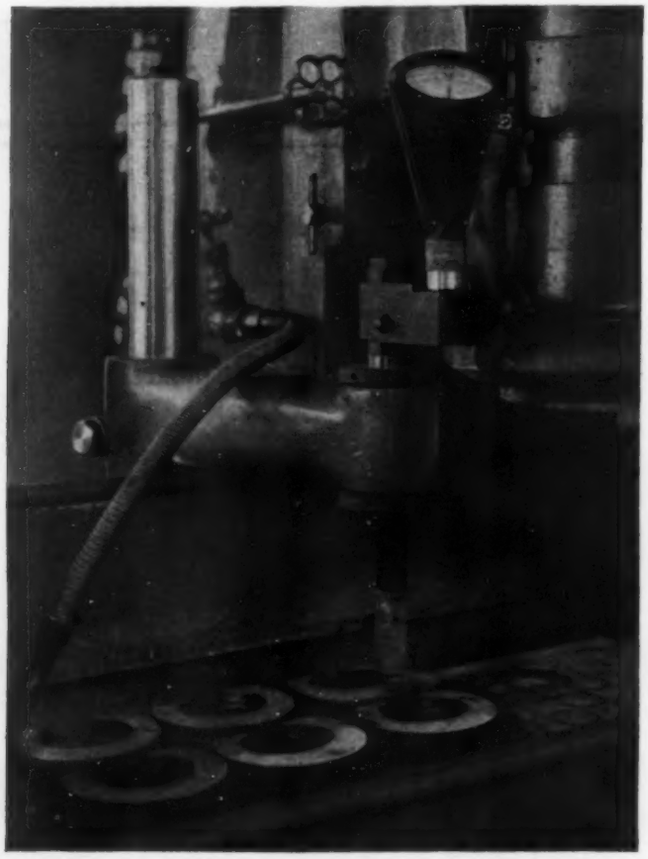


Fig. 7—Initially set by gage blocks, this feeler may be raised and lowered periodically to check surface-ground work

In the product of the Heald Machine Company the bore to be ground is checked at the rear end by means of two plug gages while the machine is in operation. The two plugs are mounted in tandem on the end of a rod which runs in unison with the work spindle. This measuring rod also moves axially in unison with the longitudinal slide. The rod bears at the end of every cycle of the stroke against the rear opening of the bore to be ground under elastic pressure. As the front plug enters the bore, the rough grinding operation is stopped by an electric contact and the wheel automatically withdrawn from the bore for the purpose of dressing. When in the course of the subsequent finishing operation the rear plug enters the bore, the wheel, as it recedes, disengages the longitudinal slide motion by electric contact.

The Wotan-Zimmermann Werke embodies in its internal grinder a Krupp microtast for measuring the ground bore automatically similar to the principle used on the Heald internal grinding machine. However, while Heald uses the feeding mechanism for subdivision into the operations of roughing, dressing the wheel and finish grinding, the microtast instrument of the Wotan-Zimmermann machine is controlled by a dog on the upper slide in the shape of a friction clutch and by adjustable stops firmly attached to the machine bed.

The internal grinder made by Karl Jung is likewise provided with a diamond for dressing the wheel. The design differs, however, in that the diamond bit is set to the finish size of the work so that the wheel has to be fed against the diamond by the amount which is to be taken off in dressing.

The devices for gaging on internal grinding machines, while capable of rapid work, have the drawback that the work cannot be inspected for straightness and freedom from chatter marks while the grinding operation proceeds.

Surface grinders have also been equipped with measuring devices. Fig. 7 shows one of the instruments. This gage is set by means of gage blocks to the size of the work to be ground. The feeler may be raised and lowered by a lever and thus from time to time brought into contact with the work.

Automatic Methods for Applying Finish

Round, flat or irregular metal parts may be spray finished in one or more colors by utilizing certain cost-saving devices

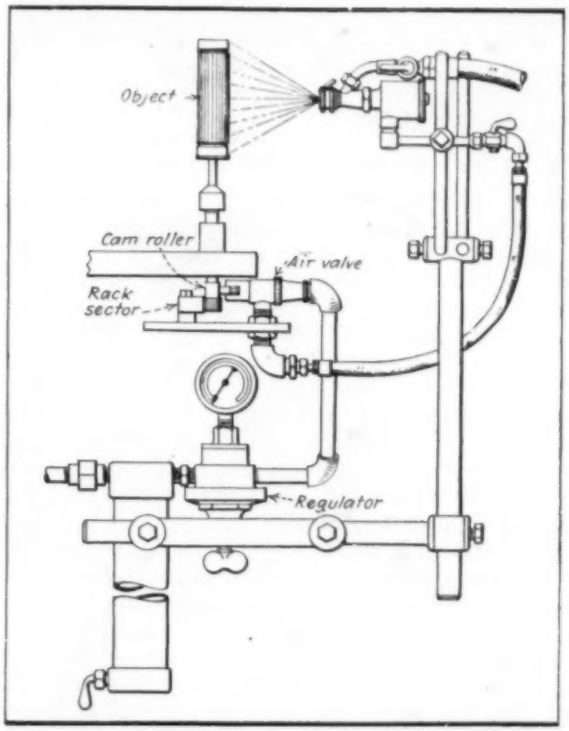
J. A. PAASCHE
President, Paasche Airbrush Company

NOW THAT conveyorization has entered practically every branch of industry, it is hardly surprising to find it gaining acceptance in the airpainting field. With it comes automatic means for airpainting regular objects that are cylindrical, round, flat or even box-shaped. Where the volume of production warrants the necessary expenditure for mechanical equipment and the greatly increased production obtained does not upset other manufacturing schedules, it is possible to obtain considerable reduction in unit cost and at the same time to improve the product to the extent of a more uniform coat. Once installed, such apparatus is flexible enough to take care of a variety of work within a reasonable range, the usual changes being slight modifications in work-holding fixtures.

A variety of automatic airpainting machines are available for painting, lacquering, oiling and decorating metal. Almost every class of liquid coating material is applicable, light or heavy. The capacity depends upon the speed at which the machine can be loaded and unloaded automatically or by hand, since the problem of getting sufficient quantity of paint or lacquer on the article in a limited time is readily solved by increasing the number of airbrushes or the volume of finish they apply.

It is possible to apply one or more colors at a time with tinted shades between, or sharply cut off. Interchangeable airbrush parts make color changes rapid when a new finish is desired. The guns cut on and off automatically for each piece, eliminating waste. Universal holders allow adjustment to any position, and the usual nosepiece gives a spray varying from a fine line to a wide fan or round pattern, so that a fine tint or a heavy coat is produced as desired. It doesn't matter how many guns are present or what position they take. It is often advantageous to incorporate a drying oven so that a second coat can be sprayed on the same piece without the necessity of removing it from the fixture, provided only that a "merry-go-round" table or other conveyor be arranged.

The means of conveying and supporting the piece depends upon the size and type of article being finished, as usually each machine is custom built for some particular class of work. Wood pieces, for example, are stuck on sharp-pointed pins; round metal objects on three or four spread forks; cylindrical, hollow bodies, such as flashlight battery cases, on cup bases with a centering mandrel or disk on the end of a pin to give them lateral support. The base can also form a shield to protect a threaded part. Stencil shields are also possible on flat objects.



As the piece passes the gun, a pinion on the end of its holder engages a rack sector, through which it is spun, while a cam opens the air valve. A universal holder allows the gun to be set at any angle

On most machines, the work spindle is in the form of a taper for ready removal of the work-holding arbor for cleaning or replacement with a different shaped arbor or platen to accommodate other parts. Spindle spacing in the original design is contingent upon the number and size of the objects to be painted. By leaving every other spindle blank, the same machine will accommodate work of larger diameter without further modification.

The easiest way to spray tiny parts is to load them on an arbor plate, charging one while the active one is in the machine. This is the procedure followed by one

manufacturer in lacquering brass inserts in the back of molded-plastic typewriter keys. The keys, face up, are placed on circular trays with the inserts projecting through slots in the plate, which acts as a shield. Two spray guns, located below, one on either side, cover both sides of the narrow, rectangular brass insert.

Depending upon the class of product finished, the work-arbor carrying member may be in the form of a variable-speed rotary table, or of a straight conveyor made of wire cable, chain or belt. A rotary table is suitable for round or tubular pieces, such as flashlight shells. A multiple-wire cable conveyor, on the other hand, serves in one installation to carry long corrugated steel sheets under the gun; also for small flat pieces. Sometimes the conveyor is a part of a special production machine.

In coating a round or tubular object, the work turns while passing the coating station. A pinion at the lower end of the work-holding arbor engages a rack sector in the spray area. According to the number of revolutions the work must make in passing the coating zone, the pinion size is variable.

Controlling Air Supply

Three methods are available for controlling the air supply: by hand, by foot, or automatically. The line drawing shows a typical arrangement of an automatic airbrush. For convenience in adjustment, the gun is held on a universal sliding and revolving arm. A cam roller on the traveling work arbor engages a spring-backed lever arm which operates the valve, turning the air supply on during the time the object passes the coating station. By proper selection of the length of this cam lever, the airbrush is kept in operation until the object has made one or two revolutions, depending upon the thickness of the coat. This control saves material and provides flexibility for light or heavy coats. When the same machine is used for coating a number of dissimilar objects in succession, the guns must be operated continuously. This gain in flexibility, therefore is at a slight loss in economy.

For continuous sheet work, or for any flat work laid end to end, it is not necessary to interrupt the flow of the spray. In this instance, the work is simply carried past the guns, which are under the control of the operator, either by foot or by hand. Sheets up to 40 in. wide have been covered at speeds up to 120 ft. per minute. In one set-up, four guns are set up in a staggered position with a wide fan spray to give maximum coverage for each.

Another example of continuous coating is a special machine for enameling electric conduit pipe. The body is in the form of a barrel, and the three airguns are equispaced in a vertical plane. A hole slightly larger than the pipe is cut in the center of the sheet metal disks covering the drum ends in order to confine the spray. Power-driven trunion rollers convey the pipe through the machine.

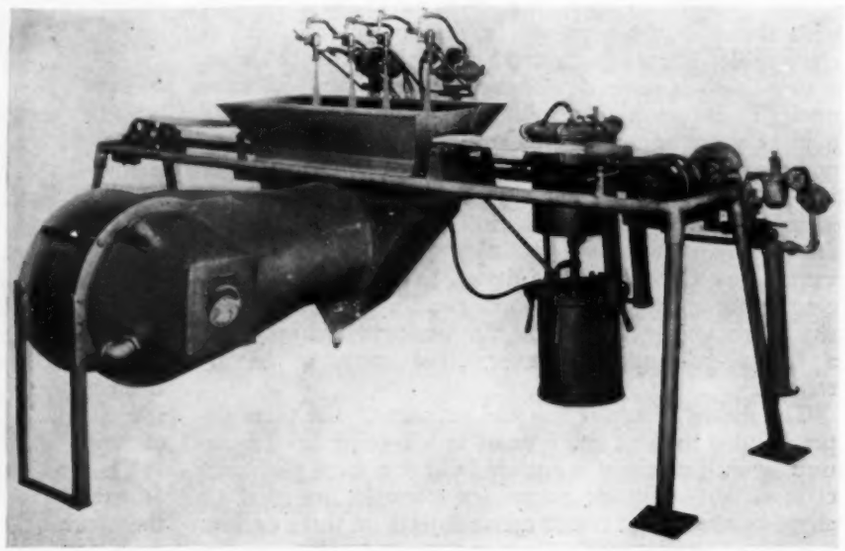
As with ordinary airpainting, provision must be made for supplying clean, dry air to each airbrush at regulated pressure. Hence, a water and oil separator is essential. An air regulator with gage is necessary for each gun to assure correct setting and timing of the spray and to provide the independent matching and volume control. The airbrush should be designed so that the needle valve effectively seals the outlet when not in use, allowing fluids to stand in the guns for long periods without gumming or clogging.

On account of the large volume of paint or lacquer consumed in an automatic air finisher, individual gravity feed cups are often impractical. A pressure tank is preferable, one having an airtight quick-clamp cover so as to be easily refilled. Selection of tank size is related to the size of the product being finished, as this governs the amount of fluid consumed in a given time. Suffice it to say that the tank should never hold less than 6 gal. and may hold 300 gal. or more.

Agitation is Necessary

Agitation of the contents is necessary for most materials for best results and to prevent formation of skin or sediment. In small tanks, bubbling air through the contents suffices, if the medium is not readily oxidized. In larger tanks, agitation is by paddles driven by an electric or airmotor connected in the same line that supplies the gun. An airmotor also furnishes a flexible unit for driving the conveyor table or chain, as it allows fine adjustment of the speed over a wide range.

The revolving table shown for use in airpainting small objects such as flashlight battery cases, metal clock dials, ash trays, and the like, is of all-steel construction, electrically welded for lightness and strength. With the vane-type airmotor, the table has a speed range from



Flat objects are carried under the guns by cable conveyor, driven either by air or electric motors. Double fluid tanks permit uninterrupted operation

Round or tubular parts are coated most easily on a rotary table. The one shown incorporates a built-in dryer oven. Unloading and loading takes place at the exit at the right. (Courtesy, Crowe Name Plate Company

½ to 2 r.p.m., but this can be changed by varying the gear ratios. The motor consumes from 20 to 30 cu.ft. of free air per minute at pressures from 5 to 70 lb., depending upon the speed desired. Control is by a disk regulator valve. To assure quiet and continuous operation of the motor with minimum wear, there is a silencer and automatic oiler which exhausts through the silencer onto the pair or worms and wheels driving the table, automatically lubricating them.

With flat-type conveyors, the frame of the unit is usually built of pipe sections or angle steel to the desired length. In a roller chain type recently constructed, by doubling the chain back on itself several times, the necessary length of travel through the built-in dryer section is available in a limited floor space. Airmotors drive this type of conveyor also, but when the unit is large, a variable-speed electric motor is sometimes substituted. The airmotor has the advantage of greater flexibility, with instant changes in speed to suit various classes of work.

No Limit to Size

With the method on construction employed there is practically no limit to the size of work suitable for automatic airspraying except minimum quantity requirements. At present, the size limit for parts sprayed on a merry-go-round table is an 18-in. cube. The object does not necessarily have to be tubular or circular in form: box-shaped objects such as switch boxes present no difficulties. With through conveyors, there is practically no limit in the length direction, and the physical dimensions of the machine limit the height and breadth. Flexible design principles make this limit unimportant. Corrugated steel sheets furnish an example of such a large size object; pressed steel refrigerator case stampings another.

Among the largest objects being airpainted automatically are steel barrels, such as are used for oil and grease storage. One barrel is coated at a time by revolving it on a horizontal axis under three spray guns capable of being shielded for multiple color work where identification bands are desired. Power-driven trunnion rollers supply the rotative effort. Discharge is by treadle action that raises the idler trunnion rollers, allowing the painted barrel to roll out by gravity to the dryer oven. By the same treadle movement, the air supply to the guns momentarily is cut off and a stop released, permitting an uncoated barrel to roll from the feed rails into the trunnion cradle; then the cycle is repeated.

To take full advantage of the process and save rehandling of parts, the drying element is built directly into the aircoating machine. Sometimes the object is to give only a quick dry in the machine to eliminate damage from handling, and letting finish drying take place in cabinet ovens. In the standard rotary unit illustrated, there is a triple-walled, rock-wool-insulated drying tunnel extending around two-thirds of the circumference of the table. Electric elements, controlled by an oil switch at the rear, give two degrees of heat, one for bringing the oven rapidly up to temperature, the other for continuous operation. The temperature selected depends upon the type of material sprayed and the time required for drying.

Ventilating methods differ little from that used for fixed spray booths, except that the ducts are closer to the work. This condition calls for care in the selection of the number and position of baffles to keep down the loss of material. Underwriter's requirements specify a fireproof motor for driving the fan in these direct draft systems.

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How They Grind Tools

Discussion

JOHN KOPP
Foreman, Simonds Saw & Steel Company

THE ARTICLE "How They Grind Small Tools" (*AM*—Vol. 76, page 289) was of interest to me. The problem seems to be complex to the writer, yet I believe it is quite simple to solve.

The gist of the problem seems to be whether to segregate small tool grinding or have it done at various places throughout the shop. I believe either method is quite satisfactory, providing the person in charge knows right from wrong methods of sharpening.

The ordinary twist drill is probably most commonly used and perhaps most abused. I have many times wondered how the operator, who turned a drill into the tool crib last, ever wore a hole through any kind of metal. In some cases, I know that the drill would have cut better had the direction of its running been reversed.

All this abuse is caused by ignorance. I believe that if the operator is instructed, or better still, shown how a drill is sharpened properly, and what happens when it is wrong, he will cooperate for his own benefit.

If the operator were shown just what the cutting edges of a drill are, how these cutting edges must be relieved

to eliminate unnecessary friction, why both cutting edges should measure the same length, why the included point angle of approximately 120 deg. make for steering a truer course with less strain on the drill body, he couldn't help but want to do the right thing. This instruction, with an occasional check-up by the foreman, will produce satisfactory results whether the drill is machine or free-hand ground. I know, however, that large drills are always best when they are sharpened by mechanical methods.

Sharpening taps, or reamers, is in all cases a machine job and should never be allowed to be done free-hand. Taps are always sharpened on the face of the thread and in the flutes and never on the periphery. Reamers are always ground on the periphery but only on the entering end, slightly tapering and with little relief. Since these last two items come within the machine-ground class, the place doesn't matter so much as the method.

With the advent of tungsten and tantalum carbide and chromium plated tools, it is advisable that a new technique be employed. Since the tools faced with these new alloys are so valuable, they are more satisfactorily ground by trained men who are familiar with their characteristics.

Efficiency Allowance in Timestudy

HAMILTON SMITH

Base Rate	Cents over Base Rate									
	$0.01	$0.02	$0.03	$0.04	$0.05	$0.06	$0.07	$0.08	$0.09	$0.10
	Per Cent Increased Efficiency									
0.25	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00
0.28	3.57	7.14	10.71	14.28	17.86	21.43	25.00	28.57	32.14	35.71
0.29	3.45	6.90	10.34	13.79	17.24	20.67	24.14	27.58	31.03	34.48
0.30	3.33	6.67	10.00	13.33	16.67	20.00	23.33	26.66	30.00	33.33
0.31	3.23	6.45	9.68	12.90	16.13	19.36	22.58	25.81	29.03	32.26
0.32	3.13	6.25	9.38	12.50	15.63	18.75	21.88	25.00	28.13	31.25
0.33	3.03	6.06	9.09	12.12	15.15	18.18	21.21	24.24	27.27	30.30
0.34	2.94	5.88	8.82	11.76	14.71	17.65	20.59	23.53	26.47	29.41
0.35	2.86	5.71	8.57	11.43	14.29	17.14	20.00	22.86	25.71	28.57
0.36	2.78	5.56	8.33	11.11	13.89	16.67	19.45	22.22	25.00	27.78
0.37	2.70	5.40	8.10	10.80	13.51	16.21	18.91	21.61	24.31	27.01
0.38	2.63	5.26	7.90	10.53	13.16	15.79	18.42	21.06	23.69	26.32
0.39	2.56	5.13	7.69	10.26	12.82	15.38	17.95	20.51	23.08	25.64
0.40	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00
0.41	2.44	4.88	7.32	9.76	12.20	14.63	17.07	19.51	21.95	24.39
0.42	2.38	4.76	7.14	9.52	11.91	14.29	16.67	19.05	21.43	23.81
0.43	2.33	4.65	6.98	9.30	11.63	13.95	16.28	18.60	20.93	23.25
0.44	2.27	4.54	6.82	9.09	11.36	13.63	15.90	18.18	20.45	22.72
0.445	2.24	4.49	6.74	8.99	11.24	13.48	15.73	17.98	20.22	22.47
0.45	2.22	4.44	6.67	8.89	11.11	13.33	15.55	17.78	20.00	22.22
0.46	2.17	4.35	6.52	8.70	10.87	13.04	15.22	17.39	19.57	21.74
0.47	2.13	4.25	6.38	8.51	10.64	12.76	14.89	17.02	19.14	21.27
0.48	2.08	4.17	6.25	8.33	10.42	12.50	14.58	16.66	18.75	20.83
0.49	2.04	4.08	6.12	8.16	10.21	12.25	14.29	16.33	18.37	20.41
0.495	2.02	4.04	6.06	8.08	10.10	12.12	14.14	16.16	18.18	20.20
0.50	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00
0.51	1.96	3.92	5.88	7.84	9.81	11.77	13.73	15.69	17.65	19.61
0.52	1.92	3.85	5.77	7.69	9.62	11.54	13.46	15.38	17.31	19.23
0.53	1.89	3.77	5.66	7.55	9.44	11.32	13.21	15.10	16.98	18.87
0.54	1.85	3.70	5.56	7.41	9.26	11.11	12.96	14.82	16.67	18.52
0.55	1.82	3.64	5.45	7.27	9.09	10.91	12.73	14.54	16.36	18.18

WHEN setting piece-work rates by timestudy, the allowances to be given are often a matter of concern for the timestudy observer. Of these allowances, some of them, such as time necessary for changing tools, machine attention, moving trucks and personal needs, can be set from standards arrived at by previous timings. The allowance for efficiency, however, that is, the allowance for extra skill and speed of the operator over that of the average, causes a degree of perplexity to the observer. It is of such a nature that it cannot have curves plotted for it or standards set. The timestudy text-books meet the problem by telling us that an average of a number of studies, taken on different operators, should be used as a basis for setting the price. But the conditions obtaining in a large number of shops do not permit of this method being carried out. It is possible only in those manufacturing one particular product and with several operators on the same operation. In those plants engaged in more or less diversified production, it becomes a matter of judgment for the observer.

The efficiency allowance is always expressed as a percentage of the net working time of the job, and it is on this point that I offer what I have found to be a decided help and one that has been adopted with appreciation by other timestudy observers. I found that, keeping in mind the basic rate per hour for the class of work to which the job belonged, it was natural, and comparatively easy, to form an estimate of the earning rate per hour the worker was entitled to, judged by his skill and movement during the study. The cents difference between this estimated earning rate and the job's base rate are then converted into a percentage of the base rate. From this, the accompanying table was made up.

A further advantage of stating the efficiency allowance in cents was found when explaining the study to the foreman or operator whenever that become necessary. Cents were more easily comprehended than percentages.

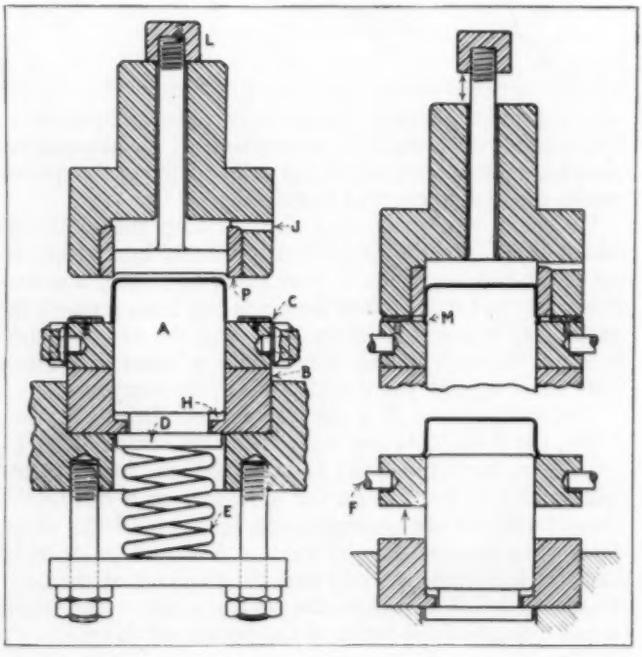
IDEAS FROM PRACTICAL MEN

Beading Cups on a Press

WALTER WELLS
Designer, Metropolitan Engineering Co., Newark

IN A FACTORY that had no cup beading machine, there arose the need to bead some small cups. Moreover, since this operation was on but one of a set of 97 stampings to be assembled in a electrical unit, it seemed probable that a definite economy could be effected by using a punch and die. The illustration shows a cross-section of the die. The hardened plunger *A* conforms to the inside diameter of the cup and maintains this size in a sliding fit in the bearing ring, *B*, and the die *C*. The disk, *D*, is secured to the shouldered lower end of the plunger with 4 fine-thread screws. The spring *E* tends to press the plunger upward until the disk stops against the shoulder of the ring. The gap *H* provides more than enough clearance for the descending movement of the plunger.

The punch ring is press fitted and peened in the punch holder. The drilled hole *J*, one of a pair, facilitates withdrawal of the ring from the holder, if necessary, and also permits a free flow of air as the knockout moves up and down. The stem of the knockout passes through the holder and terminates in a thread. The nut *L* is bottomed positively onto this thread, acting as a stop for the knockout. The small tapped hole allows the escape of air when screwing on the nut, while an inserted screw serves as a lock. Sturdy construction of the stop member is necessary because of the pounding it receives from the knockout bar.



The inside diameter of the punch is 2.089 in., allowing for twice the thickness of the stock, minus just enough to give a slight ironing effect to the cup. A forward taper of 0.0005 in. on both the punch and plunger prevents sticking. The knockout is a sliding fit in the punch. The radius is turned on this member by comparing it to a cup sawed in half. The radius, being 90 deg., would leave a feather edge. This must just be skimmed off. Such a tiny gap will not cause an impression on the cup if the face of the knockout seats perfectly. The knockout is nickel steel, left unhardened.

The die is hardened and ground internally. There is an annular groove on its upper face which nests $\frac{1}{32}$ in. of the cup during the beading, and holds it straight. The normal height of the plunger in relation to the die is determined by seating a cup over it and allowing $\frac{1}{64}$ in. clearance between the rim of the cup and the bottom of the die groove. This clearance takes care of slight variations in cup length.

The action of the die is as follows: A cup is slipped over the plunger. As the ram descends, the punch and the knockout strike the cup at the same time. The punch advances, ironing the stock, while the knockout retreats until it bottoms in the holder. The cup being confined at all points except at *M*, can only bulge there. When the desired curve has been found a pair of disks can be screwed on the die to establish a setting.

Centerdrill marks, or holes, on the surfaces of the plunger, knockout or punch that come in contact with the cup cause impressions and should be avoided.

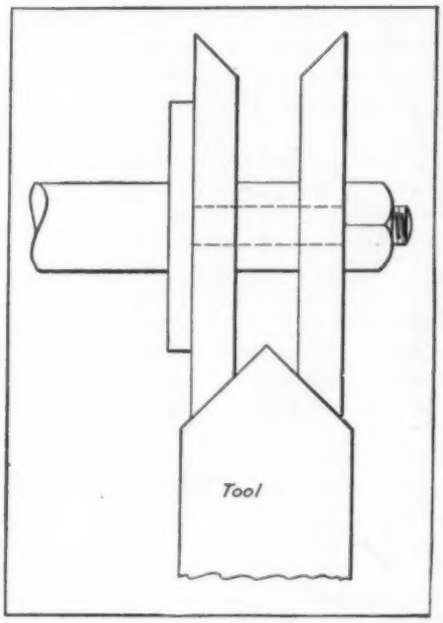
Tools for Chamfering Washers
Discussion

CHARLES KUGLER

In discussing my original article under the title given above (*AM*—Vol. 75, page 213), Arthur Silvester (page 859) suggests doing the work in the lathe. While his article is interesting, I do not believe that his method is as good as mine.

Mr. Silvester says he believes that my tools are too costly in proportion to the value of the work done. There is no expensive machine work on my tools. Of course, the shank has to be turned, the keyway cut and the taper plug made, but all other parts are as they come from stock. When I consider that nine operations are required to finish one washer in the lathe with Mr. Silvester's tools, as against three in the drill press with mine, and since a lathe is the more expensive tool, I fail to see where his tools are an improvement over mine. Even though my tools cost more to make, their increased production warrants the extra cost.

The nine operations necessary to do the work with Mr. Silvester's tools are as follows: put work on mandrel; place nut or wedge in position and tighten, using a wrench or a hammer; start machine; move the carriage; stop machine; pick up wrench or hammer; remove nut or wedge; and remove the work. The three



operations on the drill press with my tools are: place the work on the stud; move the spindle; and remove the work. There is no starting or stopping the machine and no wrench or hammer to be handled. The grooves made in the holes by the edges of the square plug biting into them are so small as not to be noticed, unless attention is called to them.

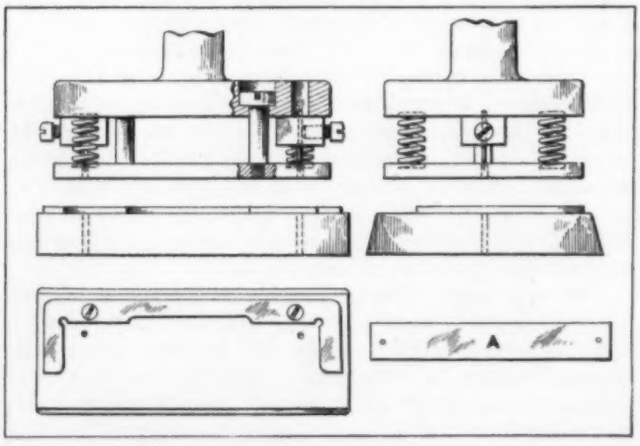
Now if Mr. Silvester will make a slight change in his method of doing the work in the lathe, with his own tools and without any additional expense, he could chamfer two washers in the time he now takes to chamfer one. The change requires a spacing collar and a tool ground as shown in the sketch.

Discussing the same subject, A. Dana Seeds (page 860) suggests that a ball-bearing extension be put on the plug, so that the part bearing on the washers will be stationary during the chamfering operation. It does not seem that this would be necessary, since past experience has shown that the plug does not wear the washers or dig into them. I believe the reason for this is that the plug is not in contact with the washers long enough to do any damage, since they are under pressure only in the few seconds necessary to do the work.

Piercing Small Holes in Fiber

ROBERT R. GOLDTHROP

Some time ago, I had the job of piercing two small holes in each of many thousands of fiber blanks, such as the one shown at *A*. The holes had to be of various sizes to hold resistance wires of different gages. When but a few thousand of the blanks had to be pierced, the job seemed to be a simple one, but it became more difficult when many thousand were required.



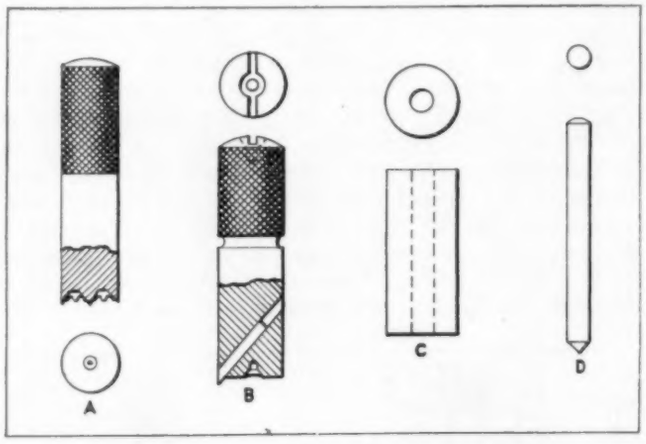
At first we tried drilling, but the expense caused by drill breakage was too great. Then we tried piercing with regular punches with but little better success than drilling, owing to the small punches becoming quickly dulled and breaking. Then I made the tools shown in the illustration and used phonograph needles for punches. This solved the problem, for the needles being supported by the stripper would pierce several thousand blanks without breaking, even though the operator would sometimes get two blanks at a time in the press.

By raising or lowering the needles in the punch-holder we could make larger or smaller holes, because of the taper of the needle points. After the wires were passed through the holes, the fiber would close upon them and hold them tightly, which it would not do when the holes were pierced by a regular punch.

Tools for Transferring Holes—*Discussion*

GEORGE SIEGRIST

I was much interested in the article under the title given above by Edward Heller (*AM*—Vol. 76, page 21). I made the same kind of tools years ago, but found that on large sizes too heavy a blow was required to get the circular impression. This necessitated spending considerable time on the upkeep of the tools. My next attempt



was to grind notches in the circle of the punch, as at *A*. The notched tool made an impression of dashes and required a lighter blow, but if the point of the center punch breaks off, the whole tool is ruined.

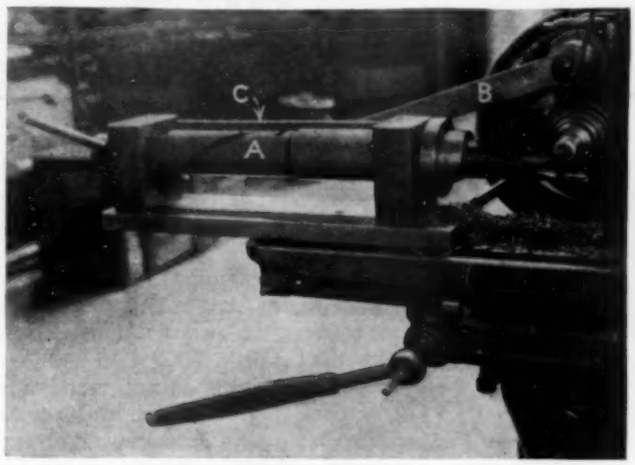
The next tool made was for scribing the circle, as shown at *B*. The tool is ordinarily rotated by the fingers, but if the hole in which it works is a deep one, a screwdriver can be used. After the circle has been scribed, the bushing *C* is inserted in the hole and the center punch *D* is put through it and struck with a hammer. These tools stood up for years with little upkeep expense.

The scribing tool *B* is made in sets of three. For example, the $\frac{3}{4}$-in. tools are made to scribe circles of $\frac{11}{16}$ in. —0.002 in. for a tap drill; $\frac{47}{64}$ in.—0.002 in. for a reamer drill; and $\frac{3}{4}$ in.—0.002 in. for a reamer or a body drill. Three bushings are required, one for each of the above sizes. The knurled part of the tool *B* should be $\frac{1}{64}$ in. in diameter less than the body and the diameter of the body should be 0.002 in. below the nominal size. Care must be taken to grind the point of the center punch true.

Cutting an Angle on a Tube End

CHARLES F. HENRY

Cutting a thin pipe with a hacksaw, and especially at a steep angle, is hard on saw blades. Besides it is not easy to get just the right angle. As the Kinner motor uses quite a number of such pipes a simple milling fixture was rigged up as shown. This fixture, consisting of a base or framework carries a sleeve with a cam cut on the outside as at *A*. The stationary pin that works in the cam groove is on the arm *B* and is held in a slot in the bar *C*, fastened behind the cam sleeve.



The hand lever on the milling machine feeds the table carrying the tube and passes the end of the pipe under the end milling cutter, as shown. The lever at the left of the sleeve allows it to be turned in a cross-cam groove when desired. The fixture is built up by welding the end blocks to the base plate.

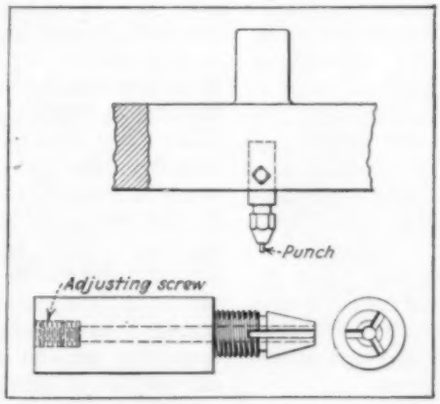
Piercing Heavy Stock With Small Punches
Discussion

ROY V. WADE

Scotstoun, Glasgow, Scotland

The article by John J. McHenry under the title given above (*AM*—Vol. 75, page 572) was of especial interest in our works, as we were faced with a similar problem some years ago. In cold-rolled low-carbon steel 0.120 in. thick we had to pierce holes 0.080 in. in diameter.

As originally designed, the tools were of the ordinary numbering, piercing, and blanking type. At first we used a hardened bushing in the stripper to support the punch, but a change in the design of the part necessitated some change in the stripper.



Eventually, we abolished the supporting bushing leaving a hole in the stripper sufficient to clear the cap of a small drill chuck, in which was gripped a straight punch of 0.081 in. diameter. The amount the punch projected from the chuck was kept as little as possible. The chuck had a straight shank, which was held by a setscrew in the punch-holder, the thrust of the punch being taken by a screw in the end of the shank, as shown in the illustration. To adjust the height of the punch, it was necessary only to remove the chuck from the punch-holder and turn the screw in or out, according to the adjustment required.

Later, we effected an improvement in the performance of the tools by making the punch from needle wire swaged down to 0.081 in. in diameter. These tools gave every satisfaction in nearly ten years of use. Our regular production was 30,000 parts between grindings of the tools.

SEEN AND HEARD

JOHN R. GODFREY

Continuous Conduit Making

All conduit is made from skelp, or flat sheet of a width equal to the circumference of the finished conduit, formed and welded. The four processes formerly used have been combined in a continuous automatic mill by Fretz-Moon Tube Company. The seam welding furnace used is much smaller, different in design and more effective in heat transfer than previous types. The body of the skelp requires a bending heat only, while the edges must be brought to welding heat.

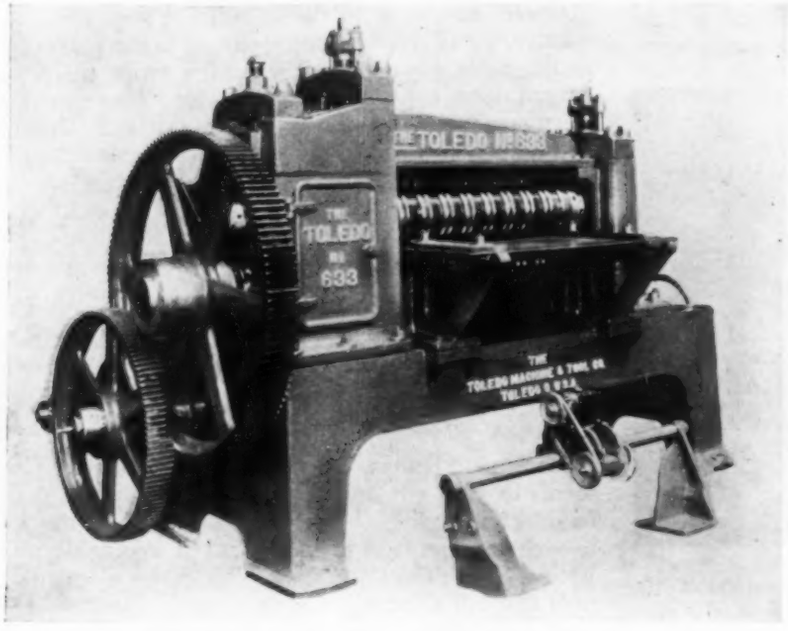
This is accomplished by placing a row of gas burners firing against the edges of the skelp, which passes through at 150-225 ft. per min., depending upon thickness. Forty of these burners are placed on each side of the 125-ft. furnace, firing through bell-mouthed refractory tunnels. As the skelp leaves the furnace, at a temperature around 2,500-2,600 deg. F., it is roll-formed to conduit shape with the edges in close contact. The additional heat required for welding is acquired by playing a jet of air on the edges. Reaction of the oxygen of the air and the carbon of the steel raises the temperature to 2,800 deg., when rolls press the edges together to complete the seam. Several sets of sizing rolls shape the conduit; then a high-speed rotary saw cuts it to length. The saw is mounted on a carriage which carries it at the speed of the conduit while it is cutting off and then returns it for the next cut.

A Line on Costs

One automotive parts supplier has an interesting and effective control of operating costs. The methods engineer controls all manufacturing processes as well as tool design, tool making, time study, and rates. Under him comes the production engineer who is responsible for costs. To the latter the trouble men report.

The methods engineer keeps a curent record of actual costs which is compared to the estimated cost on which the selling price is based. Any discrepancy shows up at once and the production engineer is given the job of bringing the operation in line.

SHOP EQUIPMENT NEWS



Toledo Gang Slitting Machine

DESIGNED to cut a sheet of indefinite length into any desired number of strips without camber and with high accuracy, the capacity of this machine is 25 cuts in 0.025 thickness steel with a maximum distance apart of the outer cutters of 36 in. A lesser number of cuts can be made in heavier steel. The minimum distance between cuts with standard adjustable cutter hubs and burrs is $5\frac{3}{8}$ in., while the distance with the burrs up and down is $3\frac{3}{4}$ in. However, by the use of packed cutters it is possible to cut strips as narrow as $\frac{1}{2}$ in. Cutters revolve at $19\frac{1}{2}$ r.p.m., and the sheet travels through at approximately 46 ft. per min.

The small operating gears run in oil in a gear box on the left-hand side. All gears are protected by metal guards. Provision is made for quickly changing the width of the strips to be cut, and there is also an arrangement for attaching a long table for holding the sheets so that they may be fed readily. The slitter is fitted with a special cutter grinding attachment which permits grinding the cutters without removing them from the shaft. It is operated by a 20-hp. motor running at approximately 900 r.p.m., and geared directly to the machine. Total weight is approximately 13,000 lb. It is manufactured by Toledo Machine & Tool Co., Toledo, Ohio.

Allen-Bradley Four- and Five-Button Motor Control Stations

Four-button and 5-button stations have been added to the line of Bulletin 800 push-button control stations manufactured by Allen-Bradley Co., 1311 South First St., Milwaukee, Wis. The Type N-1060 series of 4-button stations has three running buttons, giving three motor speeds, and one stop button. These buttons may be designated as: first—second—third—stop; slow—medium—high—stop; fast—slow—start—stop; 600-1,200-1,800—stop, or any other figures showing the three motor speeds. They are used extensively with automatic switches for three-speed motors of the squirrel-cage type.

Addition of a two-way lever switch to the above stations converts them into the Type N-1090 series of 4-button stations. The two lever positions may read "off-on," "inch-run," or "safe-run."

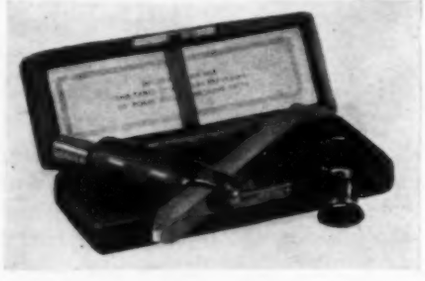
The 5-button stations, known as the Type N-1080 series, are for use with four-speed motors.

Poldi Hand Brinell Testing Apparatus

Of the familiar impression comparator type but more compact than designs previously marketed, a hand Brinell testing apparatus is being marketed by Poldi Steel Corp. of America, 245-247 W. 18th St., New York City. The pocket-size carrying case includes test bar, magnifying glass and booklet of instructions.

In use, the standard steel rod supplied with the unit is inserted into a casting between an anvil and a hardened steel ball. The anvil extends through the casing, as indicated. The apparatus with the rod in place is simply put over a smooth spot on the material whose hardness is to be tested and is struck a light blow with a hammer. The indentation in the standard steel bar and the indentation in the material to be tested are then measured by the magnifying glass and compared for size by means of a table included in the booklet.

This method may be used for testing all kinds of malleable iron and



steel in the same manner as the standard Brinell ball impression test is used except for high alloy steels. Tensile strength measured by the ball impression method is claimed not to differ more than plus or minus 5 per cent from the real tensile strength of steels between 72,000 lb. and 142,000 lb. per sq.in. With steels below a tensile of 72,000, and also with steels having a tensile of over 142,000 lb. per sq.in., the variation between the tensile figure obtained by the Poldi apparatus and an actual tensile test may be plus or minus 10 per cent.

Century Electric Capacitor Motors

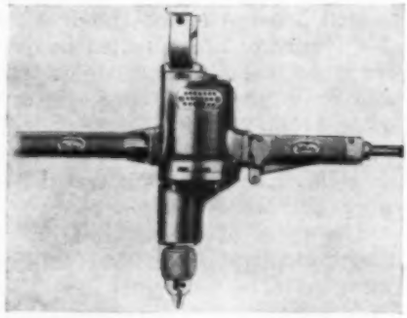
Supplementing its other lines of single-phase motors, Century Electric Co., St. Louis, Mo., has offered a line of capacitor motors in sizes from $\frac{1}{6}$ to 10 hp., furnished for single or multispeed operation with normal, high or low torque characteristics, to meet requirements of each particular application. Small sizes have the capacitor box mounted above the motor, although the boxes can be furnished for wall mounting as in larger sizes. Integral sizes have a separate capacitor box, which may be furnished for either wall or floor mounting.

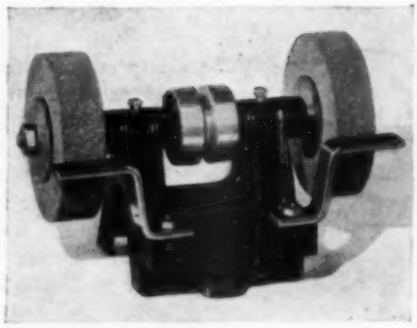
"Sorwal" Industrial Filter

Claimed to save as high as 44 per cent in grinding wheel cost because the wheel does not load up, and capable of filtering all makes of grinding compound, kerosene, light oils and similar liquids, this industrial filter is intended for installation on grinders, lapping or honing machines. It is claimed to permit use of a finer grit wheel, thus cutting down scratching and permitting savings in dressing and diamond cost. The filter is mounted on the line anywhere between the pump and the wheel outlet or may be mounted in battery to handle any amount of grinding compound if individual pumps are not in use. On the average job the filter is flushed for two minutes every five hours. It is manufactured by Fostoria Machine & Tool Co., Fostoria, Ohio, and available from Electric Auto-Lite Co., Toledo, Ohio. In one typical installation on crankshaft pin grinding, the wheel spindle operated at 6,500 s.f.p.m. and the work at 70 r.p.m., with a coolant mixture of soluble oil, soda and water. Side walls $\frac{1}{4}$ in. high are held to 0.002 in. limit, with 0.02 in. stock removed on diameter, 0.002 in. on walls. The number of pins finished between dressings of the wheel without the filter was 84, and with the filter, 120.

Modern Series P110 Light-Duty Grinder Heads

Arranged for mounting on bench or stand, a series of light-duty grinder heads is being marketed by Modern Grinder Manufacturing Co., 112 South Second St., Milwaukee, Wis. The cast frame is provided with two bracket-type adjustable tool rests and is finished in red enamel. The $1\frac{1}{2}$x$1\frac{1}{2}$-in. pulley is arranged so that flat, V, or round belts may be used. Bearings are oiled directly from self-closing oil cups. The unit is supplied with two 4 or 5-in. grinding wheels, one coarse and one medium, or with one buffing or wire wheel and a grinding wheel. Height from base to center is $3\frac{1}{2}$ in., and from wheel to wheel $5\frac{1}{2}$ in. Bench space required is 4x4 in., spindle diameter is $\frac{1}{2}$ in. and length 9 in. Weight of the head complete is $6\frac{1}{2}$ lb.





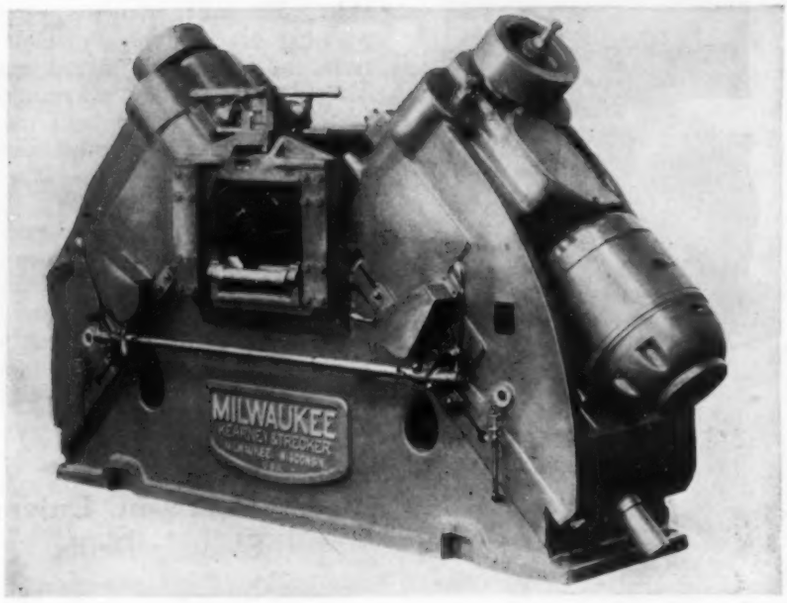
Thor $\frac{1}{4}$ and $\frac{1}{2}$-in. Universal Electric Drills

Aluminum and ball-bearing construction is used in these two electric drills, a $\frac{1}{4}$-in. size with grip switch, known as the USA, and a $\frac{1}{2}$-in. size with side switch, designated as URA. The USA has a speed of 2,500 r.p.m. and weighs 8 lb., while the URA runs at 500 r.p.m. and weighs $14\frac{1}{2}$ lb. The latter is equipped with a side handle and combination spade handle and breast plate. Both are manufactured by Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.

Armature shafts of these tools are of alloy steel with pinions milled directly upon them to avoid this possible source of vibration. Armature cores are of the open straight slot-type to permit use of separate form-wound coils laid into the slots without being flattened. Commutators are units independent from the shafts, and are balanced and tested at 1,100 volts before assembly.

Precision ball bearings of the closed back type are used throughout the tools and are lubricated from the gear case. Switch is of the double-pole type, breaking both sides of the line at the same time. It is fully protected from dust and dirt. The switch on the USA is operated by a long lever and is so arranged that it can be changed to either safety first or positive switch by pressing the lock button on the side of the gun-type handle.

Field case and handle are of aluminum in one piece with rib work on the inside. Field case, gear case and centerplate have hardened and ground steel bushings into which the outer races of the bearings fit. Both ends of the spindle are provided with oversize ball bearings.



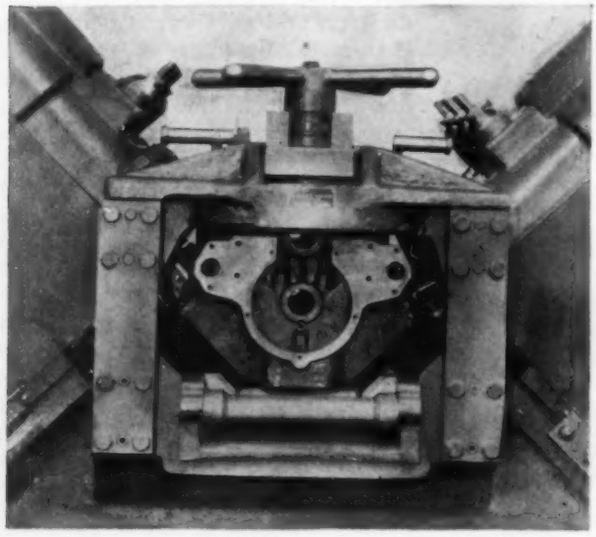
Milwaukee Six-Spindle Milling Machine for Ford V-8 Cylinder Blocks

A SPECIAL six-spindle milling machine has been designed and built by Kearney & Trecker, Milwaukee, Wis., for milling three exhaust pads on each side of the new V-8 cylinder block. The entire machine has been designed for the purpose of using tungsten carbide, although the machine will first be run with Stellite. It weighs complete 13,300 lbs.

There are two 3-spindle heads, one at each side of the bed, mounted on angular slides which feed upward together so that all six pads on the cylinder blocks are milled simultaneously. Each head is driven by a 7½-hp., 900-r.p.m. motor. Individual feeds to each head are available, although they are both arranged to operate simultaneously at a feed of 15 in. per min. Feed changes are made by pickoff gears conveniently located between motor and flywheel.

All spindles are mounted in quills for individual adjustment to compensate for cutter wear. Adjustment is made by means of a crank and dial which is graduated in thousandths of an inch. Each quill is operated by a worm and bronze rack.

The cycle of the machine is entirely automatic. Both heads feed upward at 15 in. per min. until all six pads are milled. Then the feed is automatically disengaged and the heads reversed at a rapid traverse rate of 150 in. per min.



Feed to the heads is by means of two large screws 3 in. in diameter, having a double thread of ⅜-in. pitch, ¾-in. lead. Both heads, as well as the fixture, are operated by dual control so that the operator can stand on either side of the conveyor and completely control his machine.

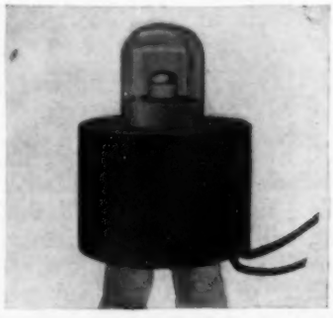
The machine sets directly in the conveyor line so that the workpieces roll into one side of the machine, are clamped and milled, and roll out on the opposite side of the machine. The fixture, shown in the close-up is made entirely of steel. The cylinder block feeds in on rollers to an approximate stop, is finally located by two disappearing dowels and clamped by the large 4-spoke handwheel.

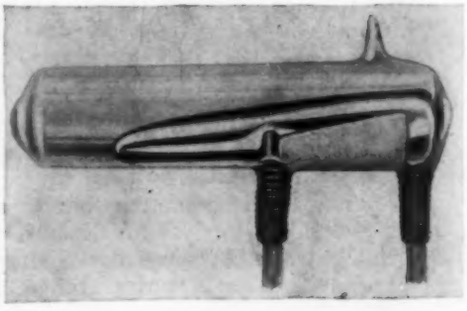
Provision for chip removal has been made by putting cored openings at the top of the bed on each side of the fixture so that chips fall down into the bed of the machine and can be removed through two back chip holes. Production is 85 to 90 pieces per hr.

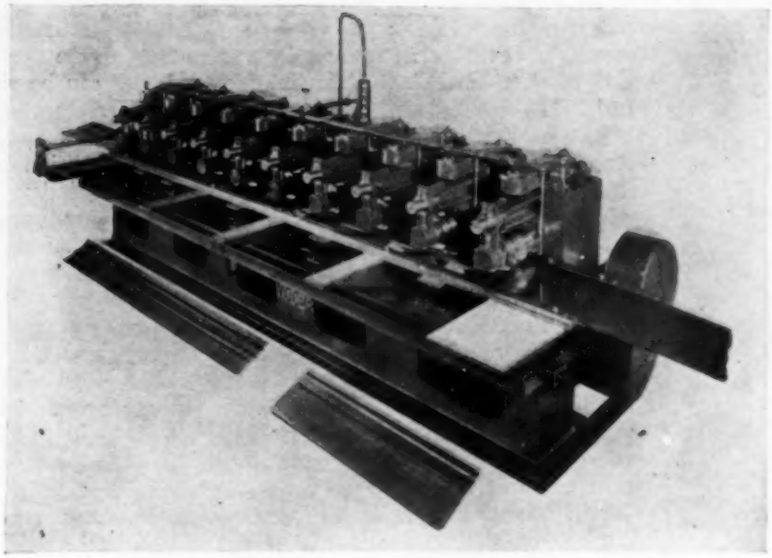
"Magnetrole" Mercury Switches

A full line of improved mercury switches, ranging in capacity from 1 to 100 amp., is being introduced by Providence Electric Controls, Inc., 763 Allens Ave., Providence, R. I. In types having a rating up to 5 amp., special heat-resisting contacts are used. In the larger switches arcing takes place over a ceramic surface to eliminate danger of tube breakage.

The "Magnetrole" mercury switch operates entirely by magnetic control. A gas-filled tube containing two mercury pools and a floating displacement member is placed within the field of an electrical coil. When the coil is energized the floating piece within the tube is drawn down to displace a certain amount of mercury. This causes a rise in the level of one of the mercury pools to make contact.







Yoder OW Open-Side Cold-Rolled Forming Machine

EASE of access to the roller dies, quick changing possibilities, compact construction and silent operation feature this OW series of open-side forming machines. Worm and spur gears run in oil. A V-belt drive is employed, provision being made for inclosing the motor in the base. The motor also may be attached to the end of the machine or direct connected to the worm drive shaft.

In this series, manufactured by Yoder Co., 5500 Walworth Ave., Cleveland, Ohio, each unit is furnished with a roll irrigating device which flushes all rolls and contact points. A separate motor is used, and the flushing compound is collected in a reservoir welded inside the base. Lubrication is provided for all bearings.

The electric control box is equipped with the usual starting, stopping and reversing buttons and also an "inching" button to permit the operator to propel the first piece of material through the machine an inch at a time while the rolls are being adjusted to their proper positions. Moreover, the pushbutton control box is mounted on a swinging conduit bracket movable to within easy reach of the operator from whatever position he may take in attending the machine.

Bearings are installed at the end of the shafts outside the forming rolls to permit easy adjustment of the roll pressure and to avoid the tendency for shaft deflection at the bearings. Bearings are kept in alignment with each other by use of a rigid bearing arm, and roll pressure is maintained by means of a rigid backup support provided with an adjustment screw located immediately over the mid-line of the forming rolls. Roller bearings and their supports at the outer end of roll shafts are detachable to permit quick roll changes. Wide adjustment of guide rails is provided to accommodate working of material of unusual width. Between roll-forming dies are benches to which are attached the intermediate guiding, supporting and holding-down devices.

LaPointe Rotor-Kut Broach

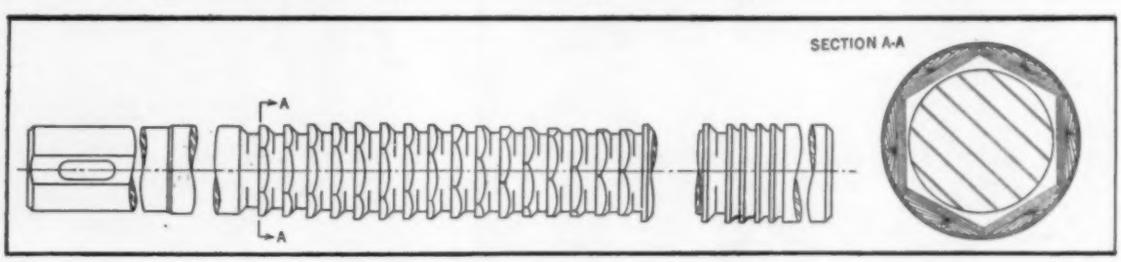
Taking both roughing and milling cuts, this "Rotor-Kut" tool has polyangular cutting or broaching sections. It will finish-broach forged, pierced, or cored holes from the rough without preliminary boring or reaming, is available from LaPointe Machine Tool Co., Hudson, Mass., and has been patented under number 1739220.

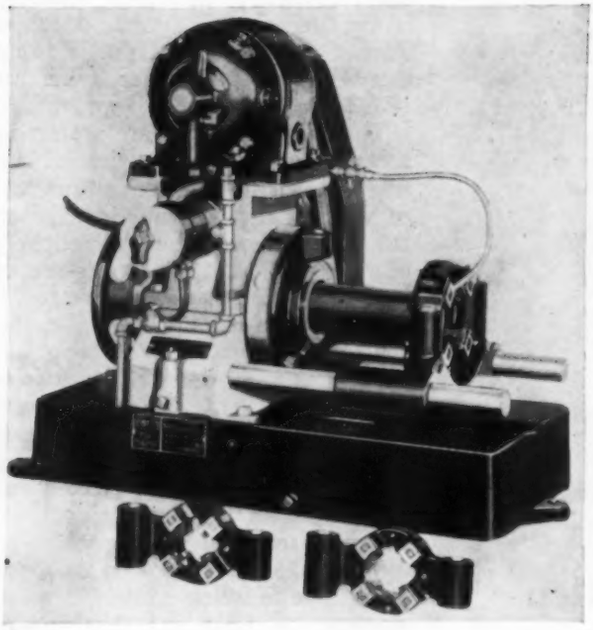
The cutting sections are preferably arranged in groups or series, all cutting portions in each series being out of axial alignment with each other, but evenly spaced about the periphery of the broach. The cross-section *A-A* is of a tool designed for broaching holes in a cast-iron housing. Its roughing section is 22½ in. long, and it removes about $\frac{5}{16}$ in. of stock from the hole diameter. The entire broach removes 0.255 in., on the diameter, and is 41¼ in. long. A similar broach for machining a 1.15-in. pierced hole 2¼ in. long in a steel forging has a roughing section 1 ft. long which removes 0.115 in. of stock on the diameter. The finishing section increases diameter to 1.318 in., thus making total stock removal 0.168 in. on the diameter.

Similar broaches can be designed for cutting splines, internal gears and square, rectangular or irregular shaped holes. The manufacturer claims increased life, production and stock removal with a shorter broach. It will remove scale or excessive stock without difficulty or injury to the broach.

Oster No. 512 Tom Thumb Pipe Machine

A low-priced portable pipe machine with capacity of ½- to 2-in. pipe is being manufactured by Oster Mfg. Co., 2067 E. 61st Place, Cleveland, Ohio. The machine is a compact, motor-driven unit and has an extra capacity down to and including ¼ in. It can be furnished with or without oil pump and base containing oil reservoir. It can also be furnished either with or without a pipe cut-off attachment. Dies are of the segment type held solidly in a holder. A separate diehead is used for each different size of pipe so that no time is lost in changing dies, the diehead being merely slipped on two vertical





studs on the carriage. When cutting off, the diehead is swung out of the way to provide clearance. A multiple-V belt is used for driving from motor to spiral Micarta pinion, then to a spiral gear on the worm shaft. Final drive to the spindle is a triple-thread worm mounted on Timken bearings automatically oiled. A three-jaw, quick-acting, universal scroll-type chuck is mounted on the front end of the spindle and a three-jawed universal centering chuck operated by a hand-wheel is mounted on the rear of the spindle. The motor is universal, variable speed and reversible and can be operated from a light socket.

"Metallizer" Metal-Spraying Gun

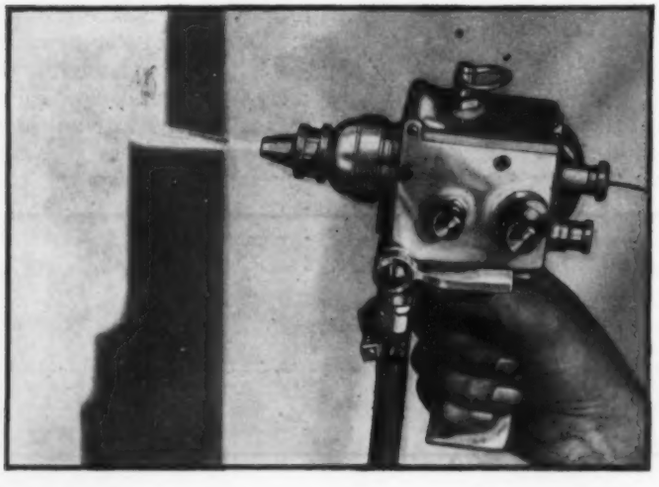
For the first time since the process was brought to this country, it is now possible to make an outright purchase of a gun for spraying metal. Metallizing Co. of Los Angeles, Ltd., 1218 Long Beach Ave., Los Angeles, Calif., has designed this unit, which is capable of spraying zinc, nickel, lead, bronze, copper, Monel metal, aluminum, brass or tin from the wire of these metals. According to the manufacturer, the process can be adapted to quantity production and can be used for spraying metal, cloth, wood, glass, plaster and most other materials for a rust-, water- and corrosion-proof coating. The gun makes a molten spray of metal from wire, fed to it from a spool. The metal is melted electrically, and the spray is so fine that the heat given off on impact is negligible. Actually the operator's hand may be held without injury in the stream of metal 2 or 3 ft. distant from the nozzle. The speed of projection is approximately 30,000 ft. per min.

Rogers No. 4 MS Circular Slitting Saw Sharpener

A bench-type automatic milling or slitting saw sharpening machine, designed for metal cutting saws 2 to 10 in. in diameter, is being manufactured by Samuel C. Rogers & Co., 191-205 Dutton Ave., Buffalo, N. Y. The machine is fully automatic in operation and is available either for belt or motor drive. An index or ratchet feed plate is a feature. By its use a worn or damaged saw can be sharpened or recut with perfect teeth of any desired shape, with uniform spacing, regardless of the condition of the teeth to be recut. The index plate makes it possible automatically to shape and space the teeth of saws as small as 2 in. in diameter with small attention from the operator. The grinding wheel arbor is equipped with SKF ball bearings, and principal moving parts are provided with adjustments for taking up wear. Floor space is 20x22x28 in. high. Shipping weight, 250 lb.

Stanley Flexible Rigid Steel Rules

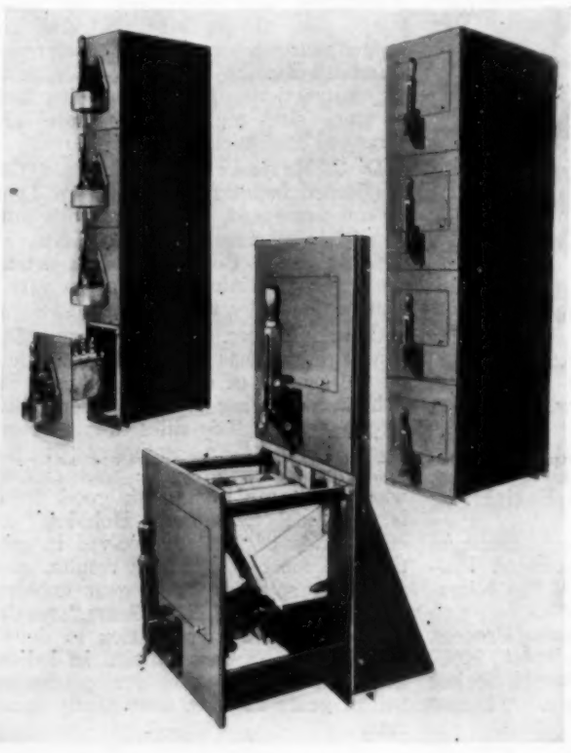
These low-priced pull-push rules with a 6-ft. steel blade, coiled in a watch-size steel case, are graduated in sixteenths of an inch. The rule is a concave steel strip that may be bent as desired and yet is ordinarily rigid like a steel bar rule. A hook on the end of the blade permits measuring beyond arm's length. Two types are available, the latter the lower-priced, the Stanley "Foursquare" pull-push with a chromium-plated steel case and a ½-in. wide blade and the "Defiance" pull-push with a nickel-plated steel case and a ⅝-in. blade. Both are manufactured by the Stanley Rule & Level Plant, New Britain, Conn.



Roller-Smith Sectional Steel Dead-Front Switchboards and Cubicles

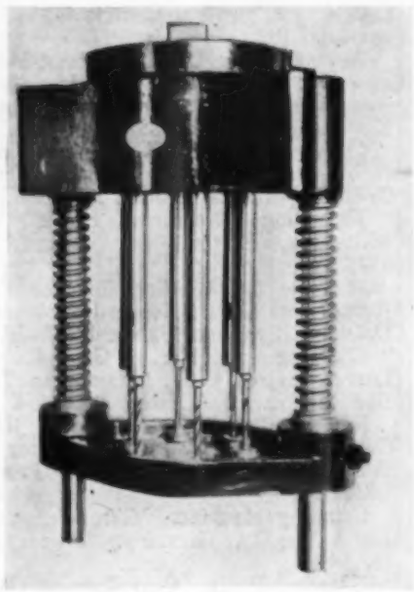
Air or oil circuit breakers, indicating and recording instruments, dead-front knife switches, and combinations of these four may be put in this line of sectional steel dead-front switchboards. The switchboards are assembled from standard units which are sufficiently flexible to take care of the needs of any installation. These units are placed one above the other to form a stack and stacks are placed side by side to form a section or complete switchboard.

Each unit consists of two parts, the frame and the removable breaker carriage. The unit frame is a welded steel skeleton which may be stacked as desired. The breaker carriage consists of a front plate, the breaker on a slate base and a tie between them. It is slid into position from the front of the board and when removed, the breaker may be operated and adjusted. The front plate is of stretcher leveled steel with flanged edges and is provided with a door so interlocked with the handle that it cannot be opened when the breaker is closed. When the breaker is opened the door may be opened for inspection and adjustment. It may be padlocked in the closed position. The breaker is closed by an upward motion of the handle, and manual opening is provided by an outward pull on the handle. Provision is made for quick-break. Where instruments are required, they are installed on the front plates. An ammeter may be installed on the front plate of each unit. These switchboards are manufactured by Roller-Smith Co., 233 Broadway, New York City.



Morse Wide-Pitch Roller Chain

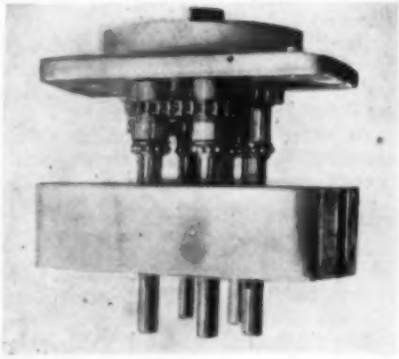
Morse roller chain, described originally two years ago in *American Machinist,* has just been made available in a full range of pitches up to 2 in. This chain is manufactured by Morse Chain Co., division of Borg-Warner Corp., Ithaca, N. Y.



Ace Multiple-Spindle Drill Heads

Replacement of the usual gear train by sprockets and a driving chain feature "Ace" multiple-spindle drill heads. The driving shaft has mounted upon it three hardened sprockets from which power is transmitted through high-safety chain to each two driven spindles. This lessens the load upon the individual drive. The head is claimed to drive six $\frac{3}{4}$-in. drills at 1,200 r.p.m. with a chain speed of only 700 r.p.m.

In other respects, this drill head placed on the market by A. H. Pearson, 7 East Grand Ave., Detroit, Mich., follows conventional design. A new type of oil seal is used, which while permitting sufficient oil to reach the lower bearings, precludes oil leakage. It consists of a bronze disk which rotates with the drill spindle, and is mounted above and in contact with the radial ball bearing in the lower case of the head body. While having no oil holes it allows sufficient lubricating oil of medium body to be drawn in by capillary action to supply lubricant.



The manufacturer claims that variations in load distribution are almost limitless. The number of steps of driving and driven sprockets are only limited by the height of the head body. Inasmuch as this type of head construction dispenses with intermediary idler gear plates, considerable overall height is available. A suitable take-up device is provided to take care of chain slackness.

• PATENTS •

MAY 10, 1932

Metal-Working Machinery

Means and Method of Dressing Grinders (Diamond). Adolph L. De Leeuw, Plainfield, N. J., assignor of one-half to Albert F. Nathan. Patent 1,857,142.

Milling Machinery. Lester F. Nenninger, Cincinnati, Ohio, assignor to The Cincinnati Milling Machine Company. Patent 1,857,162.

Method of and Apparatus for Soldering. John F. Donovan, East Cleveland, and Frank J. Malloy, Cleveland, Ohio,

assignors to General Electric Co. Patent 1,857,182.

Apparatus for Use in Factory Management. Laurence T. Littlefield, Rochester, N. Y., assignor to Eastman Kodak Co. Patent 1,857,204.

Chamfering Tool and Holder. Henry R. Metz, Erie, Pa., assignor to Williams Tool Corporation. Patent 1,857,208.

Threading Machine. Erik W. Mikaelson, Easton, Pa. Patent 1,857,251.

Machine for Welding Tubular Objects. Carl Gustaf Leonard Sjolander, Dalsborg, Sweden. Patent 1,857,338.

Chipping Machine. George W. Lentz, Canton, Ohio, assignor to The Bonnot Company. Patent 1,857,464.

Rotary Broaching Machine. John Oakley, Springfield, Mass., assignor to Perkins Machine and Gear Co. Patent 1,857,516.

Grinding Machine. Viktor Jereczek, Berlin-Steglitz, Germany. Patent 1,857,549.

Drawing Press. Otto Kuhner, Goppingen, Germany, assignor to L. Schuler A.G., Goppingen, Germany. Patent 1,857,648.

Forging Die. Giuseppe Benedetto, Novara, Italy, assignor to Omes Holding Co., Ltd., London, England. Patent 1,857,708.

Automatic Riveter. Chalon E. Corson and William A. Wright, Bridgeport, Conn., assignors to The Milford Rivet and Machine Co. Patent 1,858,001.

Method of and Apparatus for Burnishing Gears. Ernest C. Head, Rochester, N. Y., assignor to Gleason Works. Patent 1,858,044.

Sheet Metal Die. George E. Ireland, Toledo, Ohio, assignor to The City Auto Stamping Co. Patent 1,858,047.

Apparatus for Cutting Pipe for Angle Bends. Frank J. Douglass, Chicago, Ill., assignor to Douglass Brothers Co. Patent 1,858,076.

Pipe Cutting and Beveling Apparatus. Frank J. Douglass and Albert S. McCawley, Chicago, Ill., assignors to Douglass Brothers Co. Patent 1,858,077.

Apparatus for Cutting and Beveling Pipes. Frank J. Douglass and Albert S. McCawley, Chicago, Ill., assignors to Douglass Brothers. Patent 1,858,078.

Grinding Machine. Herbert A. Silven, Worcester, Mass., assignor to Norton Co. Patent 1,858,222.

Tools and Attachments

Bevel Gage. Harold Ahola, Stevenson, Wash. Patent 1,857,129.

Vacuum Power Hammer. James C. Campbell, New York, N. Y., assignor to Portable Air Hammer Co. Patent 1,857,138.

Tube Marking Device. Frank S. Speicher, Pittsburgh, Pa., assignor to M. E. Cunningham Co. Patent 1,857,166.

Safety Mechanism for Material Handling Machines. Charles H. Wagner, Washington, D. C., assignor to Koehring Co. Patent 1,857,172.

Oxy-Carbon Blowpipe. Francis S. Austin, Pittsburgh, Pa., assignor to Carbo-Oxygen Co. Patent 1,857,344.

Conduit-Tapering Tool. Alwin G. Steinmayer, Milwaukee, Wis., assignor to Line Material Co. Patent 1,857,483.

Thread Chaser. William T. D. Campaigne, Spooner, Wis. Patent 1,857,493.

Control for Electrical Welding Currents. William E. Crawford, Wauwatosa, Wis., assignor to A. O. Smith Corporation. Patent 1,857,499.

Metallic Arc Welding Electrode. Richard Stresau, Wauwatosa, and John J. Chyle, Milwaukee, Wis., assignors to A. O. Smith Corporation. Patent 1,857,521.

Device for Automatically Advancing Perforating Hammers by Sliding on a Support. Pierre Gouge, Paris, France, assignor to Societe Metallurgique de Normandie, Paris, France. Patent 1,857,686.

Pipe Welding Mandrel. John H. Baker, Youngstown, Ohio, assignor to The Youngstown Sheet & Tube Co. Patent 1,857,802.

Cut-Off Mechanism for Heading Machines. Charles T. Brennan, Waterbury, Conn. Patent 1,857,997.

Speed Control Gear for Machinery. Joseph Francis Naylor, Earlestown, England, assignor of one-half to T. & T. Vicars, Ltd., Earlestown, England. Patent 1,858,167.

Electric Fender Tool. Nilo Pesola, Fitchburg, Mass. Patent 1,858,169.

Processes

Manufacture of Refractory Metal Bodies. Colin James Smithells, Bushey, England, assignor to General Electric Co. Patent 1,857,219.

Method of Producing Rings. Allen W. Morton, Baltimore, Md., assignor to The American Hammered Piston Ring Co. Patent 1,857,254.

Arc Welding System. Claude J. Holslag, South Orange, N. J., assignor to Electric Arc Welding Co. Patent 1,857,306.

Method of Butt Welding by Means of a Flashing Electric Arc. Warren F. Heineman, Shorewood, Wis., assignor to A. O. Smith Corporation. Patent 1,857,505.

Method of Resistance Welding Automotive Vehicle Frames. Walter E. Richter, Milwaukee, Wis., assignor to A. O. Smith Corporation. Patent 1,857,517.

Method of Electric Welding Pressure Vessels. Howard J. Burnish, Milwaukee, Wis., assignor to A. O. Smith Corporation. Patent 1,857,526.

Manufacture of Hollow Metal Bars. McCleane Brown, Sewickley, Pa. Patent 1,857,620.

Method of Heat-Treating Axles. Bertis H. Urschel, Bowling Green, Ohio, assignor to Urschel Engineering Co. Patent 1,857,895.

Heat-Treatment of Strong Aluminum Alloys. Noak Victor Hybinette, Wilmington, Del., assignors to The Nicralumin Co. Patent 1,858,092.

Galvanizing or Electroplating Process. Michael von Devecis, Budapest, Hungary, assignor to Waldberg Societe Anonyme, Paris, France. Patent 1,858,125.

Furnaces

Enameling Furnace. Robert MacDougall, Downers Grove, Ill., assignor to Beemack Furnace Co. Patent 1,857,206.

Electric Furnace. Alfred Ruckstahl, Detroit, Mich., assignor to Holcroft & Company. Patent 1,858,062.

• TRADE • PUBLICATIONS

AIR CIRCUIT BREAKERS. Roller Smith Co., 233 Broadway, New York City, has published Catalog No. 5 covering air circuit breakers, both open and inclosed, attachments and accessories of all kinds, including relays. It also illustrates and describes a series of new sectional steel, dead-front switchboards and cubicles.

ARC WELDING SUPPLIES. Lincoln Electric Co., Cleveland, Ohio, has published a 24-page bulletin, Section 3304, covering a complete line of supplies for arc welding. A full description with prices of electrodes, electrode holders, cables, protective shields, protective lens and various supply parts is included.

AUTOMATIC SURFACE GRINDERS. Blanchard Machine Company, Cambridge, Mass., has issued a new catalog on its automatic surface grinders Nos. 16-A and 16-AZ, the latter with two spindles. Both machines are illustrated and described, and data is given on typical production jobs.

BALL-BEARING DATA. Auburn Ball Bearing Co., 57-85 Clarissa St., Rochester, N. Y., has issued the "Auburn Ball Bearing Data Book," illustrating and describing the company's ball thrust bearings, and arranged as a convenient reference manual. Bearing descriptions, mounting instructions, dimension limits, lists of stock sizes and capacity tables are arranged for quick reference.

D. C. MOTORS. General Electric Co. has issued bulletin GEA-1542 on Type B, constant-speed, d.c. motors with ball- or sleeve-bearings, in ¼ to 3-hp., at 115-550 volts. Complete design details are given and information as to variations possible by rearrangement.

GEAR HOBBING. Barber-Colman Co., Rockford, Ill., has issued three booklets on the subject of cutting gear teeth by hobbing, covering it from several different angles. The titles are: "Precision Hobbing," a summary of the problems encountered in gear cutting where accurate work with good finish is required; "Economical Hobbing," an explanation of factors involved in getting the most satisfactory results, economically speaking, from gear hobbing machines; and "Helical Gears," results of an extensive investigation to determine causes of inaccuracies in helical gears and the means for producing helical gears that are consistently accurate.

American Machinist

Reference Book Sheet

BLUING AND BROWNING STEEL ARTICLES

Bluing, browning, blacking, cyanide mottling, heat tinting, Cosletting and Parkerizing provide simple finishes for steel articles that have been polished and properly cleaned. Here are described processes and procedures

STEEL articles that have been polished and properly cleaned can be given a simple finish by immersing them in molten niter. This finish was specified for small components in rifles required by this and the Allied governments during the late war. A mixture of half and half sodium and potassium nitrate is melted in a cast-iron or steel melting pot of shape and depth to suit the work. The pot should be clean prior to putting in the saltpeter, as rust from any source affects the color of the work. The niter is melted, superheated to a temperature of about 900 deg. F. (500 deg. C.) and black oxide of manganese added in the ratio of about 1 part oxide to 50 parts of niter, by volume. The manganese gives the molten salt a greenish-black tinge, and causes all suspended matter to settle to the bottom of the pot.

As bluing by this process forms an iron oxide film on the piece, consumption of the manganese oxide would be expected. Replacement at the rate of 1 lb. black oxide every three hours to a 300-lb. batch of saltpeter keeps the bath in condition. While it is doubtful what is the exact function of the manganese dioxide, this much has been observed: that if omitted from the pot the melt does not produce good work. Baths found upon analysis to be charged with iron oxide gave bad results, whereas no excess iron oxide was found in solution in any bath containing an excess of manganese oxide.

Operation of Niter Baths

In a niter bath a peacock blue or temper blue can be consistently obtained in the following manner: Articles to be blued are cleaned, given a thin coating of oil, then immersed in the hot niter at 600 to 650 deg. F. (315 to 345 deg. C.). Pieces may be either suspended individually on wires, or screws, nuts and other small articles may be dipped inclosed in a wire basket. The parts are held in the niter for a few minutes, then raised to note the depth of coloring attained, replacing in the molten salt until they reach the desired color. Time required varies with temperature and size of pieces, but is never over four or five minutes.

The reaction is nothing more than obtaining a uniformly colored oxide film, as is obtained where tempering steel to color. If left in the niter too long, say ten minutes, the film produced is no longer a temper blue or a gunmetal blue, but has become a dirty gray. Preliminary cleaning in gasoline or similar solvent produces bad results, resulting in a mottled dirty surface. Oil carried on the surface of the parts takes fire immediately upon immersion in the hot niter, and if any moisture is present on the articles bad spattering of hot salt will occur.

After the right blue is obtained, the articles are quenched in cold, clean water to strike the color, then immersed in boiling water and finally in hot oil. Hot oil dip is very necessary in treating small screws or other tiny parts, as it removes from them all moisture, which if left on the glued article will form a spot of red oxide rust, a defect which has a tendency to form at the roots of threads or any re-entrant angle.

The lower bath temperature mentioned above yields the temper blue required by the French Government for finish of rifle parts, but the United States and the British Government require a darker gunmetal blue, to obtain which a temperature up to 1,000 deg. F. (540 deg. C.) is required.

Care should be taken not to dip articles after adding manganese oxide to a niter bath until the suspended oxide has sunk, as otherwise dirty spots will appear on a blued article. Cast iron, if highly polished, will take on a gunmetal blue corresponding to that given to polished steel, but it required about twenty minutes' immersion at 1,000 deg. F. to accomplish this result.

Oil Blackening

Among other coloring methods for finished work may be mentioned oil blackening, which gives a dull finish; cyanide mottling, which gives a highly colored and mottled surface, and drawing to color in a sand bath, yielding a range of color from straw to purple.

To oil blacken, the polished steel part is packed in a carburizing box, using spent carburizing compound, and properly luted to exclude air. Box and contents are heated to 1,200 deg. F. (650 deg. C.), requiring about 1½ hours. At 1,200 deg. F. the box may be drawn, the lid opened and the parts riddled free from carburizing compound and at once quenched in oil. A black oxide-skin is formed, dull in appearance but uniform in texture. It has proved an ideal finish for front rifle sights.

Cyanide Mottling

Cyanide mottling is obtained in a manner similar to oil blackening, except that an active carburizing compound may be used. To the spent mixture there is added approximately 5 per cent by weight of powdered potassium cyanide. Polished parts are packed in this material in a carburizing box, properly luted to exclude air, and heated to 1,200 deg. F. (650 deg. C.) for approximately four hours. Then the box is drawn, the articles are riddled free from compound and immediately quenched in oil. As air will quickly spoil the color effect, it is often advisable to quench direct from the box without riddling. If

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BLUING AND BROWNING STEEL ARTICLES

colors obtained are too gaudy, the cyanide may be omitted, pulverized charcoal being used in its stead.

Heat Tinting

A beautiful finish may be obtained by simply heating polished steel articles in a sand bath. Temperatures up to approximately 650 deg. F. (340 deg. C.) should be used, but not higher, as high temperatures tend to produce gray colored work. The sand may be on a hot plate or, better, in a cylinder capable of being slowly rotated and heated by a gas flame underneath. From five to ten minutes will produce a fine rich blue when the sand is at approximately 650 deg. F.

Parkerizing

Parkerizing and other phosphatic coatings of iron and steel yield an excellent finish. In Coslettizing, the articles, polished and cleaned, are placed in a solution of ferrous phosphate, made from iron filings, phosphoric acid and water, and the solution boiled for approximately two hours. This treatment yields a coating to steel consisting of basic iron phosphate, which is strongly adhesive. Due to the low temperature used, the physical properties of tempered steel articles are not affected, even fine springs retaining their elasticity and magnets being unaffected. The method called Parkerizing differs from Coslett's original method by adding an oxidation agent and catalyzer to the solution, usually as MnO to a 0.75 per cent solution of H PO, containing ferrous phosphate. The coating produced is then a basic ferrosoferric phosphate, the ideal coating being one containing 3 of ferrous to 1 of ferric phosphate. After coating, the articles are gray in color, and after drying are usually coated with a paraffined oil to give them a deep black color. Considerable variation of color is possible by this treatment. When the articles are first placed in the bath a large quantity of hydrogen gas is liberated, and as soon as this ceases the process is complete.

Browning

There are many processes for browning steel, each of which is thought the best by its originator or user. The matter, however, may be summarized by describing one process, in spite of numerous variations, chiefly in the composition of the browning mixture. Other variations occur in manipulation and in the atmospheric conditions, artificial or natural. The longer browning processes have relatively low temperatures and humidities, while the shorter processes have relatively high temperatures and humidities. The longer processes have poor conditions, while the shorter processes have good conditions for rusting.

The operation is conducted as follows: First, the browning solution is applied evenly over the surface of the article with a brush, sponge or by dipping. The article is then kept for a certain time in a room or cabinet where good conditions for rusting are maintained. It is then boiled in water to reduce ferric oxide to magnetic oxide. Finally the article is carded to remove any loose particles of oxide on the surface.

The work, coated with the solution, should be placed in a warm room or cabinet, where a temperature of about 175 deg. F. can be maintained. Dry heat is satisfactory, as it is its function merely to bring the article up to a temperature such that when it is placed in the humidor rusting cabinet, dew will not form on the surface, causing spots in the color.

The rusting cabinet or room should be maintained at 175 deg. F. (80 deg. C.) and at any humidity up to the saturation point.

A third cabinet or room may also be used, although it is not absolutely necessary, conditioned the same as the first. Its object is to "set" the rust.

All of these rooms should have proper thermometers and thermostatic controls, and the rusting room a recording hygrometer. Temperature and moisture should be automatically controlled. The layout of the apparatus should permit of a proper flow of work from one process to the other.

Procedures in Browning

The procedures in browning are as follows:

The articles are first thoroughly cleaned, which may be accomplished by boiling for fifteen minutes in a soda solution. Any grease appearing on the surface of such a solution indicates need of additional soda ash. Then dry the parts by placing them on a draining rack. When cooled to approximately 120 deg. F. (50 deg. C.), coat with the browning solution. Dry for approximately 30 min. apply a second coat of the solution and dry for 30 min. more.

The articles are then placed in the first warming room mentioned above, and brought to temperature, which may vary from 140 deg. F. up to as high as 175 deg. F. (60 to 80 deg. C.). With articles such as bayonets, thirty minutes in the warm room is sufficient. The time will naturally vary according to the size of the piece. Transfer them from the warm room to the rusting room. This must be at the same temperature as that of the warming room. Humidity up to the saturation point is desired, but danger of condensation should be avoided, as pitted and spotted work will result if the dew point is reached. Articles are rusted in approximately 1½ hours for such shapes as bayonets, others taking longer or shorter periods depending on the size and surface.

The rusted metal, now a dirty greenish red, is removed from the humid room to the third cabinet, if used, and allowed to remain for 30 min. Then it is placed in boiling, clean water for 15 min. The articles are allowed to drain dry, and then are carded on a wire brush or fiber wheel, which operation completes the first coating.

After the first coat, three more rustings are applied in substantially the same manner. Four coatings are necessary to make the finish required by the British Government, after which the browned surfaces are given a coating of thin white slushing oil.

Solutions for Browning

The number of solutions in use at various places total at least a score. Many formulas prescribe copperas or logwood for use in the water in which the articles are boiled after the rusting, but since omission of both of these ingredients led to the same finishes the conclusion was drawn that they were unnecessary.

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EDITORIALS

May 19, 1932

K. H. CONDIT • F. H. COLVIN
Editors

Sherman Act Revision

Driven to the point of desperation by current conditions which have given the consumer a cruel whip hand, manufacturers have at last proposed to Congress a relief measure that offers a sane solution of their problem. As embodied in a resolution adopted by the National Association of Manufacturers last week it proposes two moves: A Congressional investigation into the workings of all phases of the anti-trust laws, which would lead to a permanent remedy; pending the outcome of this investigation, an act of temporary emergency relief that would permit industries to operate without being hampered by the Sherman Act provisions, but under the supervision of the Federal Trade Commission so that the public interest would be protected.

This proposal seems to us to be eminently suited to meet the situation. No fault is found with the intent of the anti-trust laws—to prevent monopoly and unfair trade practices in private industry. Every fair-minded student of industrial regulation recognizes, however, that the actual working of the laws has led to results quite different from those expected by their framers. To mention but one fault—they have provided an incentive to capital concentration which is just opposite to what was intended.

Although a Congressional investigation leaves something to be desired as a remedy for any bad situation, it is probably the only way out of a dilemma such as this. The public must be assured that its interests are being safeguarded before any really effective remedial legislation is likely to be passed.

What appeals particularly about this whole proposal is the laboratory method of seeking a solution that is to go on while Congress is studying the workings of the law. If industry, under the direction of the Federal Trade Commission can find a way to regulate itself that works better than the Sherman Act, the type of revision that is needed will be clear.

We do not hesitate to experiment with materials, with designs, with production methods, with markets. Why should we not employ the same approach to so vital a problem as this one?

Penny Wise

Real economy is to be commended at any time and especially at present. But saving a few dollars now at the cost of thousands a little later is far from being a real economy. A case in point is in connection with a sand-blasting operation where the exhaust system was so neglected as to permit fine sand to be distributed over the plant and in the offices.

Aside from the effect on machinery bearings and the anoyance to workers in shop and office, there is the real danger of silicosis with attendant damage suits that may run into huge amounts a little later. The danger of silica sand or dust in the lung tissues is now thoroughly understood and damage suits are cropping up in various sections.

Simplifying Taper Shanks

Ever since the standardization of taper shanks has been under discussion by engineering committees, the problem has been complicated by the conflicting requirements of drilling and milling tools. Drills, for example, can be centered and held by a fairly steep taper while milling cutters, depending on the taper fit, sometimes work loose even with the half-inch taper per foot of the Brown & Sharpe system. While large milling cutters long ago ceased to depend on a taper fit, the small cutter has complicated the problem until recently.

This complication has largely been removed by the successful efforts of the milling engineers in providing a simple steep taper holder with a lock-

ing device that can be used on the smallest cutters in common use. This device has the advantages of requiring less stock in the cutter shank, of holding the cutter securely under all conditions and of allowing it to be readily removed without the possibility of sticking when removal is necessary.

With milling cutter requirements divorced from the problem of taper shanks only the needs of the drill users and makers need now be considered. The new device permits using the same holder for milling cutters and for either straight or taper shank drills by the use of suitable collets or sleeves. There is a possibility that this feature may in time affect the whole question of tapers, and lead to a general use of straight shank drills.

• CHIPS •

Breakfast at the White House . . . President Hoover and Senate bipartisan committee seek to reorganize economy program sadly torn in the House . . . a last drive to balance budget before Congress adjourns . . . President gives notice that emergency war powers may be employed to combat economic situation . . . vetoes Democratic tariff on basis that it opens domestic policy to international discussion . . . and indorses un-American policy of discrimination . . . Two billion dollar relief plan proposed in Senate . . . would issue bonds for public works . . . grant states $300,000,000 credit for job-providing projects . . . and adopt 30-hour week . . . But Administration favors less expensive compromise . . . House votes to drop 2,000 army officers . . . Gen. McArthur protests . . . House committeee in accord with Winston Churchill's suggestion for world monetary parley.

Some parts of U. S. see prices at 1832 level according to the Department of Agriculture . . . Texas eggs, 7 cents a dozen . . . Tennessee butter 17 cents a pound . . . North Dakota chickens 9 cents a pound.

"Legislative legerdemain" says Merchants Association of Goldsborough bill . . . Modification of anti-trust laws advocated by Manufacturers Association . . . would stop waste caused by destructive competition . . . Business and bank failures continue to decrease . . . Check payments show sharp increase . . . I. C. C. hearings on 6-hour day disclose that cost to railroad would be $600,000,000 annually . . . fixed charges could not be met . . . Equalizing fee is Owen D. Young's recommendation for slump cure . . . R. R. Brotherhoods urge Smith plan for 25-year moratorium on war debts.

Chancellor Bruening prefers cancellation . . . also approves lowering of tariff barriers and reduction of armaments . . . Militarists terrorize Tokyo . . . slay Premier Ki Inukai . . . bomb banks . . . No substitute for gold basis say bankers, meeting at Basle . . . supply adequate . . . but Peru joins countries that have abandoned it . . . Soviet buys 150,000 tons of Spanish sheet iron . . . may lead to future deals in lead, copper, cork . . . Germany's idle roll decreases 197,000 in 2 weeks . . . Finance Minister Mosconi says Italy will not balance budget . . . Imperial Airways' eight new planes are world's largest . . . Handley-Pages with 140 ft. wing span . . . but handle easily . . . In 1917, a German czar of the Atlantic would have been thought impossible . . . but Lederer, traffic head of Hamburg-American, is given the job.

United Action Drive to employ 1,000,000 reports 764,837 put to work . . . in 2907 communities.

Autogiro creator, Juan de la Cierva, gets Guggenheim medal for Promotion of Aviation . . . Pennsylvania cuts application for loan in half . . . to $27,500,000 at suggestion of R. F. C. . . . Ford nears 2,000 daily . . . Chrysler payroll biggest in three years . . . Plymouth for first quarter is 385 per cent over 1931 . . . General Motors sales to consumers increase 67 per cent in April . . . National Cash Register reports accounting machine orders ahead of 1931 . . . Norge Corporation sales for first quarter 241 per cent over last year . . . April showed sixteenth consecutive monthly increase . . . Illinois Central recalls 1500 men . . . puts 1100 part-time employees on full-time basis . . . Missouri Pacific reopens shops . . . 750 return to work . . . U. S. Steel to decentralize control . . . may divide corporation into four regions with almost complete autonomy . . . Thrift gardens grow as relief measure . . . sponsored by five states and many corporations . . . United Air Lines report April passenger traffic 150 per cent over 1931 . . . Building activity up 20 per cent in April . . . More sales in first quarter than all last year reported by the Bird Machine Company, makers of paper mill machinery . . . John D. Gregg will spend $750,000 for a new cement products plant at Van Nuys, Calif. . . . to employ 275 men.

· REGIONAL · REPORTS ·

NEW YORK—Machine tools in slight demand here during past week. Sporadic sales mostly small items, partly to Navy, some to small plants. No important orders, no large or promising inquiries reported. Dealers grateful for even minor items once mere routine business.

NEW ENGLAND—Slightly improved tone in machine tool market. Prospects among metal-working companies offered chief source for renewed confidence. Better volume of orders for single machines. Small tools showed slight gains and inquiry was sharper. A few industries have taken on new help, some temporarily, others for indefinite period. No further development as regards Amtorg orders. Auto manufacturers make occasional purchases, usually for large machines, but equipment of new design for high-speed production, being pushed through, is certain to result in new business of substantial volume. Henry & Wright Mfg. Co., Hartford, shipped two carloads of new style steel presses to Statesville (Ill.) prison for manufacturing number plates.

PHILADELPHIA—Little change in situation here during last two weeks. Local dealers and agents interested in report Lycoming Motors plans to install crank and crankshaft equipment. Dealers in automobile equipment find auto sales picking up, but production off. Scientific measuring instruments and other shop equipment still inactive.

CINCINNATI—Small orders came from various classes of users. When additional equipment is needed, some firms are keeping down outlay by buying used tools to be replaced with new when business improves. Fair number of inquiries coming in, but buying is postponed.

CHICAGO—With local situation practically unchanged, dealers face dull and unprofitable summer, cut overhead, but keep cheerful. Industrial production low. Borg & Beck busy on clutch parts for Plymouth. Grigsby-Grunow back into production on radios and refrigerators with 2,300 men. Westinghouse Elevator still buying tools. Rockford district dull.

ALTHOUGH the National Machine Tool Builders' Association report shows an increase of approximately 10 per cent in gross orders for April and also an increase in unfilled orders, there has been little change in the situation. The gross orders for May are as likely to show a decline as a further rise. The April index of 41.1 is based on 100 per cent average monthly shipments for 1922-23-24. In reality machine tool builders are operating, by and large, at about 20 per cent of capacity. From all regions of the country come reports of scattered sales, mostly of single tools for special uses. In some spots, slight increases in activity are noted, but these are ephemeral. No real upturn in machine tool orders is looked for until after the passing of summer. What the fall will bring no one knows, but at least some betterment may be expected then.

NEW YORK passed through another quiet week. A slightly better tone was noted in New England where prospects among metal-working companies offered some source of renewed confidence. Philadelphia's situation remains about the same. Cincinnati manufacturers are buying used tools to be replaced later. Chicago faces a dull, unprofitable summer. Detroit, feeling the feeble pulse of auto activity, looks for even duller times. Milwaukee, too, is feeling the pinch of restricted tool demand, and in the Southwest there is no sign of improvement, in the immediate future.

DETROIT—No change in sales or inquiries. Level still low, promises to be even lower before summer is over. Some changes in design planned by leading manufacturers of automobiles. One large firm plans considerable re-tooling but not many new machines. Car sales still so slow, makers not spending for equipment. Ford, Chevrolet and Chrysler, however, maintain production schedules. Ford buying a little machinery. Only scattered inquiries being received.

MILWAUKEE—First half of May saw no change in machine tool industry. Demand remains sharply restricted; production schedules continue to drag; inquiry, while not active, somewhat improved. Practically all new business relates to automotive plants. Most Ford orders completed. Metal-working shops lack fortification of orders to increase output and employment. No immediate need for new equipment. New business from agricultural machinery makers has not materialized. Railroads not interested. Electrical industry counted on to give tool business considerable volume during the next several months.

SOUTHWEST—No particular change in machine tool and shop supply business in Los Angeles and vicinity. One or two specialty and tool shops report moderate increase in their lines but production factories still wait for "better times" which appear nearer.

MATERIAL TRENDS AND PRICES

With the rate of mill operations unchanged in the last week, steel prices remain untested for want of an appreciable volume of orders. Demand from the automotive industry has decreased slightly, while that from the railroads has developed signs of improvement since May 6. Principal price changes of the week in non-ferrous metals consist of declines in copper wire, scrap light copper and slab zinc. Tin, however, fluctuated erratically. Uncertainty prevails in the copper market owing to pending tariff legislation. Little iron or steel scrap is being released by principal sources of supply.

(All prices as of May 13, 1932)

IRON AND STEEL

Pig Iron —	Current	Mo. Ago	Yr. Ago
Birmingham, No. 2, Fdry., per gross ton	$11.00	$11.00	$12.00
Buffalo, No. 2, Fdry., per gross ton	16.00	16.00	17.10
Heavy Melting Steel Scrap — Pittsburgh consuming point, No. 1, per gross ton	9.75	10.00	11.25
Furnace Coke — Connellsville, per net ton	2.25	2.25	2.50
Foundry Coke — Connellsville, per net ton	3.25	3.25	3.25
Steel Shapes — Pittsburgh, base, per 100 lb	1.50@1.60	1.50@1.60	1.65

Iron Machinery Castings — Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight, 275 lb:

Chicago	4.62½	Cleveland	4.50
Cincinnati	4.35	Detroit	4.00
New York	4.75		

Steel Sheets — Prices in cents per lb., del. from warehouse stock (except at Pittsburgh) in lots of 401 to 999 lb., ordered and released for shipment at one time:

	Pitts. Mill	Chicago	Cleveland	New York
Hot-rolled, No. 10	1.55	3.20	3.00	3.00
Hot-rolled, No. 24*	2.20	3.55	3.25	3.50
Galvanized, No. 24	2.85	4.10	3.75	4.00

*Annealed

Seamless Steel Tubing — Cold-drawn mechanical tubing, round, .10 to .30 carbon, in lots of less than 100 ft. or 100 lb., net, at N. Y. warehouse:

Thickness of Wall		Outside Dia. in Inches						
Inches	B.w.g.	¼	⅜	½	⅝	1	1¼	1½
		Price per Foot						
.035	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23

Shapes, Plates, Bars, Etc. — Warehouse base prices in cents per lb., del. in lots of 401 to 999 lb., ordered and released for shipment at one time:

	New York	Cleveland	Chicago
Bands	3.40	3.00	2.95
Bars, soft steel	3.10	2.75	2.75
Cold fin., flat or square	3.80	3.60	3.60
Cold fin., round or hexagon	3.30	3.10	3.10
Cold rolled strips	4.95	5.95	5.50
Floor plates	4.85	5.00	5.00
Hoops	3.75	3.55	3.50
Rivets	4.00	3.30	4.00
Shapes	3.10	2.95	3.00
Spring steel	4.00	4.00	4.00
Tank plates	3.10	2.95	3.00

Stainless Steel — Hot-rolled bars, base, Pittsburgh, 0.12 per cent carbon, cents per lb.:

Chromium		Chromium	
15% and under	19.00	18 to 23%	23.00
15 to 18%	20.50	23 to 30%	28.00

Bolts and Nuts — Discount from list, f.o.b. mills, Birmingham, Chicago, Cleveland and Pittsburgh, on bolts (except stove), nuts, and lag screws, mill lots 75%

NON-FERROUS METALS

Prices following are in cents per lb. for mill shipments in carlots:

Aluminum ingots 99%, N. Y.	23.30
Copper, electrolytic, Conn	5.62½
Copper wire, base, Chicago and Cleveland	8.12½
Copper wire, base, N. Y.	8.00
Lead, pigs, E. St. Louis	2.90
Tin, Straits, pigs, spot, N. Y.	21.12½
Zinc, slabs, E. St. Louis	2.50

Prices following are in cents per lb., base, N. Y., Chi. and Cleve.:

Brass rods, high	10.25
Brass sheets, high	12.50
Brass tubing, high	15.75
Copper, drawn round	12.87½
Copper sheets	15.37½
Copper tubing	14.87½

Prices following are in cents per lb., del. from N. Y. warehouse:

Babbitt, anti-friction, general service	27.00
Babbitt, com'l, intermediate grade	32 75
Babbitt, genuine, highest grade	43.00
Solder, bar, 40-60	16.00

Prices following are in cents per lb., base, Huntington, W. Va.:

Monel metal rods, hot rolled	35.00
Monel metal sheets, full finished	42.00
Monel metal tubing, seamless	65.00
Nickel rods, hot rolled	45.00
Nickel sheets, full finished	52.00
Nickel tubing, seamless	75.00

Scrap Non-Ferrous Metals — Dealers' purchasing prices in cents per lb., f.o.b. cars:

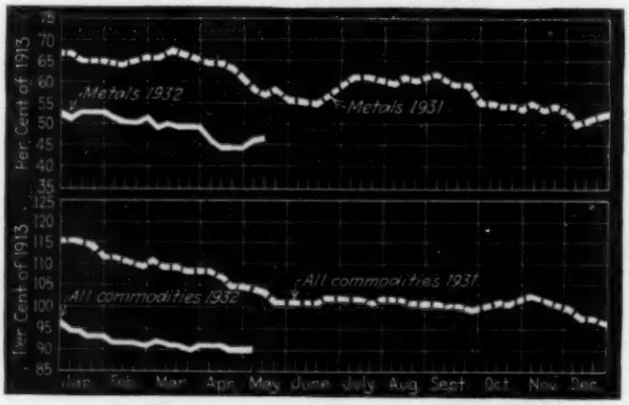
	New York	Cleveland	Chicago
Heavy yellow brass	2.00	1.75	1.50
Light brass	1.50	1.25	1.25
No. 1 rod-brass turnings	2.25	2.00	1.50
Heavy copper	4.00	2.75	2.75
Light copper	3.25	2.50	2.25

SHOP SUPPLIES

(Prices at warehouse)	New York	Cleveland	Chicago
Abrasive disks, aluminum oxide No. 50 grain, cloth, 6-in. dia., X weight, in 150-disk lots, per 100	$3.48	$3.48	$3.48
Belting, leather, heavy	40-5%	40-5%	40-5%
Belting, rubber, trans., Grade 1	60-10-10%	60-10%	60-10%

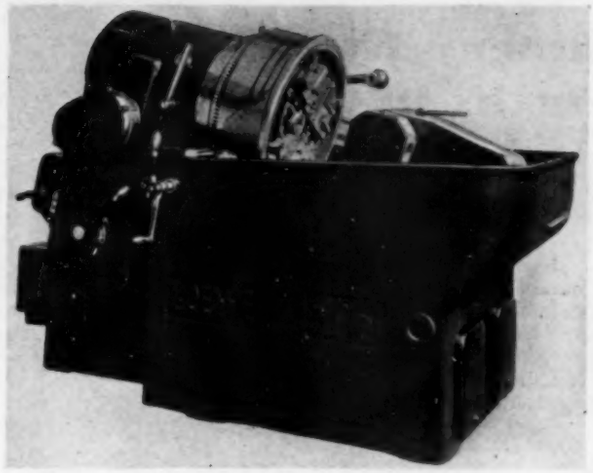
Lumber — Per M ft., b.m., 12-16 ft. lengths, delivered, N. Y.

Crating — Southern pine: 1x4-in., sq. ed	$27.00	1x6-in	$24.00
Skids — Spruce: 2x4-in.	$35.00	3x4-in.	$35.00
		4x6-in.	$37.00
		6x6-in.	$50.00


Per Cent of 1913
Metals 1932
Metals 1931
All commodities 1932
All commodities 1931
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

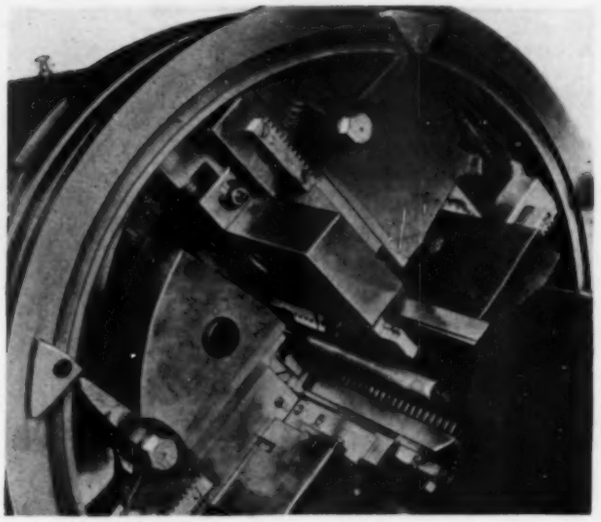
Price Movements Week by Week

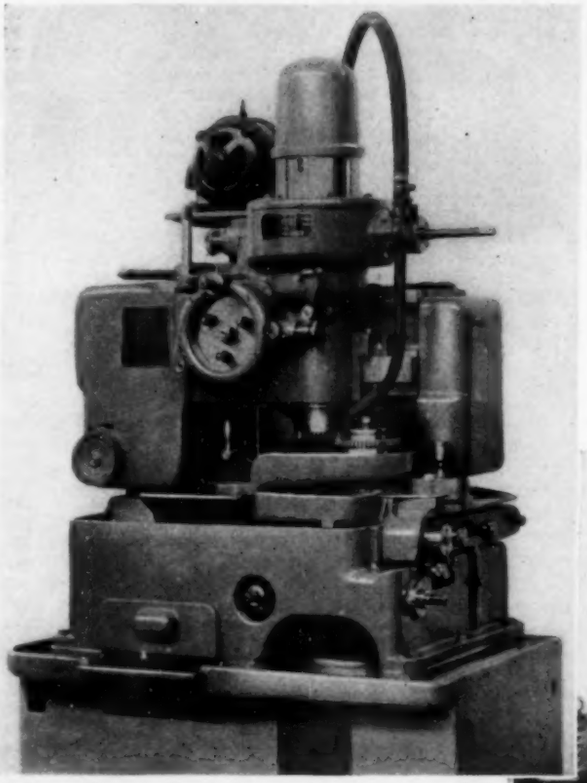
Average Price of Raw Metals: Pig Iron, Billet Steel, Copper, Tin, Lead, Zinc—American Machinist
Seventy-Four Commodities Index—The Annalist



Left—A new principle in machining, or rather the revival of a discarded principle, is incorporated in this simple automatic. It consists essentially of a method of machining a bar with four radially arranged cutting tools which are fed radially into the bar instead of longitudinally. Tools are shaped to cut the required profile, as shown in the close-up. (Below) Non-adjustable cams inside the drum are arranged for cutting-off and parting. Output is claimed to be eight times that of the usual automatic, and power required is 40 hp. Shown by Loewe Gesfürel, A. G. Berlin, the machine is known as the "Mulka Automatic." Another machine, by A. Monforts of Gladbach-Rheydt, has the control drum on the outside to permit rapid resetting

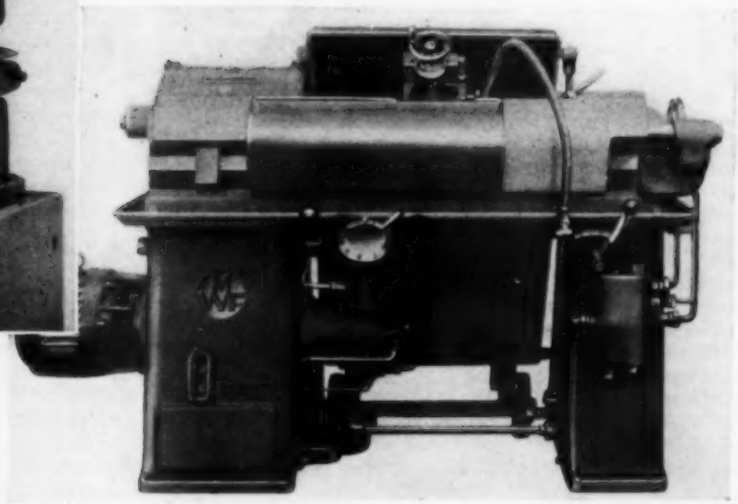
Metal-Working Machines at the 1932 Leipzig Spring Fair





Left—Gear wheels up to 1200 mm. in diameter may be cut on this high-capacity gear cutting machine. This machine will cut internal helicoids. Shown by Lorenz, A.G. Etlingen

Below—The "Chip Flow Lathe" of Magdeburger Werkzeugmaschinenfabrik is so-called because of the angular arrangement of tools, bed and chip chute which provides unrestricted chip flow. Intended for working pieces up to 6 in. in diameter and 20 in. length, the machine has speeds from 750 to 6,000 r.p.m., and hydraulic feeds from 1/64 to 1¼ in. per sec. Rapid traverse in both directions is also hydraulic. The bracket-mounted motor is 5-10 hp. Another automatic, turning forged nipples, is arranged to take ten cuts simultaneously and to machine nine nipples at once



U. S. Industrial Machinery Exports Off 37.5 Per Cent in 1931

THERE is no surprise in the fact that over-seas shipments of American industrial equipment underwent a decline during 1931. As a matter of fact they fell from $221,000,000 in 1930 to $138,000,000 in 1931, a total of 37.5 per cent according to a report of the Industrial Machinery Division, U. S. Department of Commerce. The slowing-up of production all over the world made it obvious that sales of production machinery would decline. Competition from other countries was exceptionally keen during the past year and the protective tariffs and currency fluctuations of European and other countries also presented obstacles.

As usual, Europe furnished a greater demand for this type of American equipment than any other area, its proportion during the period amounting to 53.4 per cent of the total exports of industrial machinery from the United States. However, the actual value of European purchases dropped from $89,125,000 in 1930 to $75,665,000 in 1931.

For the first time in history Soviet Russia led all other countries in its purchases of industrial machinery from the United States. In spite of this fact the volume declined from $39,800,000 in 1930 to $37,749,493 in 1931. About 60 per cent of the 1931 figure consisted of metal working machinery, with mining machinery, oil well and oil refinery equipment, diesel engines, excavators and conveying equipment among the other leading items.

Canada, previous to 1931 by far the most active market for American machinery, fell to second place. Curtailment of Canadian industrial activity and restriction of the program of public works caused a decline in the machinery market there which brought the total of American machinery imports down from $45,800,000 in 1930 to $24,400,000 in 1931. The Canadian textile industry seems to have suffered less than other fields of activity and 1931 imports of equipment from the United States to be used in this industry were $2,730,000 in 1931 compared with $2,989,000 for the previous year. With the exception of the gold output, activity in Canadian minerals was extremely dull and there was little demand for American mining equipment. Likewise shipments of metal working machinery, ball and roller bearings, and excavators and parts were considerably lower in 1931 than in the preceding year.

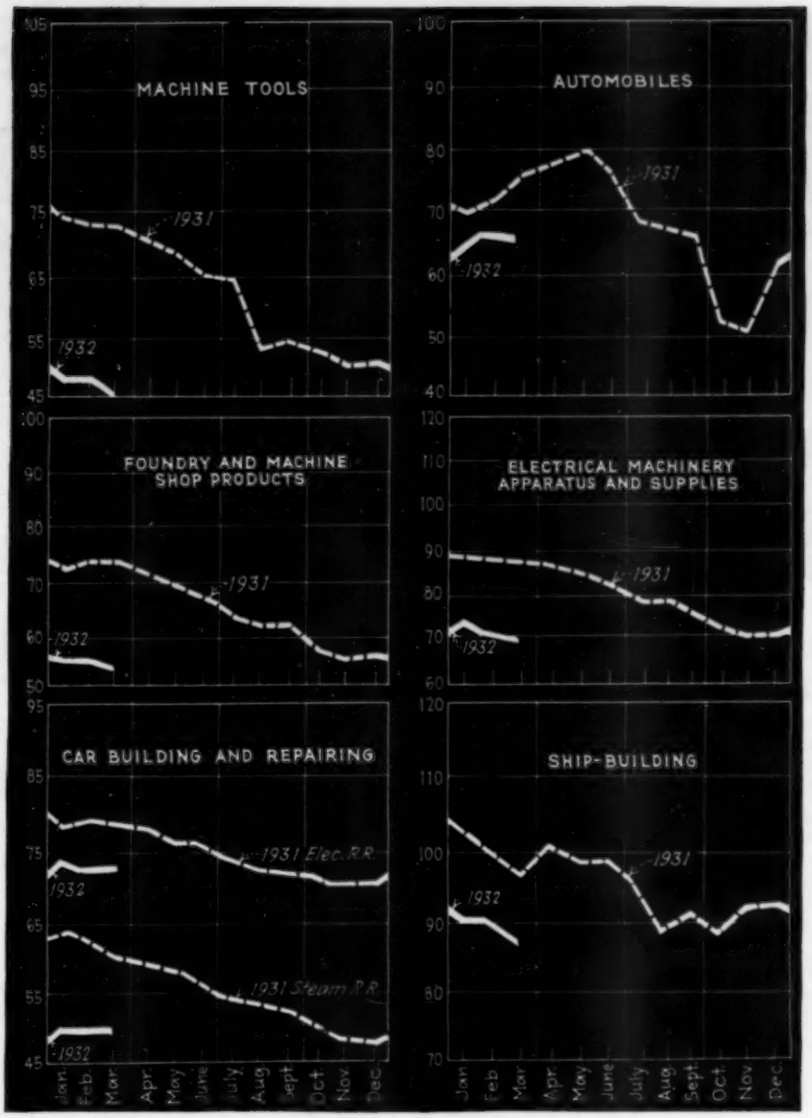
The United Kingdom maintained its third place as a market for American industrial machinery, taking $20,000,000 worth in 1931, off but 10 per cent from the 1930 level. Items of greatest demand in this market were metal working machinery, textile machinery, sewing machines, laundry machinery and mining equipment. Germany also maintained its 1931 requirements, thereby advancing from ninth place in 1930 to fourth place in 1931. The $5,260,000 worth of machinery orders placed in Germany was expecially noteworthy in view of the determined efforts on the part of German commercial interests to accumulate a favorable export surplus and the tendency to eliminate as far as possible the necessity for importing equipment from abroad. Leading items on this list consisted of metal working machinery, cigarette and cigar making machinery, oil well and refining equipment and textile machinery.

French imports declined with the lack of business activity in that country. Mexican trade was off 60 per cent and exports to Argentina and Chile were less than half as large as in 1930. Exports to all countries in order of importance are listed in the accompanying table.

United States Exports of Industrial Machinery by Countries of Destination

Country of Destination	1929 Rank	1929 Value	1930 Rank	1930 Value	1931 Rank	1931 Value
Soviet Russia in Europe	3	$13,737,779	2	$39,791,965	1	$37,749,493
Canada	1	65,657,691	1	45,839,005	2	24,370,694
United Kingdom	2	26,538,061	3	22,152,652	3	19,793,720
Germany	9	7,092,520	9	5,343,328	4	5,263,161
Mexico	4	12,327,459	4	11,895,617	5	4,776,596
France	5	12,005,549	5	8,456,691	6	4,612,053
Japan	8	8,050,989	8	6,275,022	7	3,390,391
Argentina	6	8,956,441	6	7,881,478	8	3,295,284
Chile	13	5,625,673	7	6,328,473	9	2,598,834
British India	15	4,067,382	15	3,201,865	10	2,175,020
Philippine Islands	16	4,056,533	16	2,561,461	11	1,898,673
British South Africa	18	3,889,262	11	4,179,697	12	1,836,703
Netherlands West Indies	20	3,590,002	31	1,162,034	13	1,641,067
Venesuela	7	6,309,684	10	5,156,050	14	1,636,711
Colombia	21	3,567,441	25	1,708,367	15	1,458,728
Cuba	14	4,434,459	17	2,553,474	16	1,360,155
Italy	17	3,905,280	18	2,384,548	17	1,236,305
Brazil	11	6,362,846	12	4,037,275	18	1,218,910
Netherlands East Indies	12	5,964,823	13	3,568,133	19	1,160,580
China	25	2,253,894	25	1,585,812	20	1,131,113
Australia	10	6,710,519	14	3,459,254	21	957,975
Portuguese Africa	39	761,385	30	1,175,828	22	388,286
Spain	19	3,750,142	22	1,817,168	23	847,730
Sweden	26	2,135,467	27	1,459,234	24	804,274
Peru	24	2,485,691	26	1,550,909	25	779,393
Belgium	23	2,517,663	24	1,701,024	26	767,946
Panama	(1)	(1)	34	1,008,952	27	730,802
Netherlands	27	1,805,901	33	1,093,921	28	689,615
Rumania	22	3,285,873	19	2,084,338	29	649,642
Greece	41	628,204	21	1,846,654	30	630,566
Norway	38	796,549	38	774,892	31	411,021
Trinidad and Tobago	33	1,124,975	28	1,221,345	32	391,036
Algeria and Tunisia	(1)	(1)	44	459,715	33	386,260
Uruguay	29	1,457,870	37	817,720	34	385,225
Hongkong	51	285,022	48	363,861	35	345,790
Kwantung	36	820,872	45	401,345	36	320,935
Newfoundland and Labrador	31	1,167,370	35	825,588	37	299,675
Denmark	42	590,261	41	558,988	38	288,279
Czechoslovakia	35	865,063	39	699,628	39	282,430
Bolivia	34	994,432	40	657,254	40	272,319
British Malaya	28	1,775,408	29	1,190,116	41	263,710
Switzerland	37	799,133	43	468,694	42	242,258
Poland and Danzig	43	547,535	53	267,767	43	199,724
New Zealand	50	1,300,934	36	825,531	44	199,642
Dominican Republic	44	455,959	57	216,226	45	191,980
Persia	(1)	(1)	32	1,100,354	46	191,861
Bermudas	(1)	(1)	(1)	(1)	47	186,344
Finland	45	425,125	50	324,249	48	176,406
Honduras	47	371,644	46	376,763	49	164,048
Siam	(1)	(1)	(1)	(1)	50	156,454
Ecuador	46	423,419	49	341,553	51	154,744
Guatemala	50	329,432	56	226,092	52	140,348
Jamaica	(1)	(1)	(1)	(1)	53	123,722
Nicaragua	52	255,042	55	253,186	54	113,871
Egypt	(1)	(1)	51	307,387	55	105,431
Haiti	(1)	(1)	(1)	(1)	56	103,216
Total, including other countries		$257,085,110		$220,913,051		$138,000,944

(1) Not separately classified.



Trend of Employment in Metal-Working Industries Monthly average for 1926 = 100. Data supplied by the Bureau of Labor Statistics

England Starts to Manufacture Machines Formerly Imported

London—As might be expected, one effect of the recent changes in the British import duties on machines and machine tools has been to encourage manufacture in Great Britain of such articles previously imported. Some movement in this direction shows in machine tools. It has recently been arranged that Potter & Johnson machines shall be built here and this work has already been started. Similarly, under license, certain of the Waterbury-Farrell lines are being made, and one firm at least has determined to copy a well-known German machine.

The position of the machine tool industry varies from shop to shop. Work, in fact, depends more than anything else on the value of Russian orders in hand. The one present market for British machine tools is undoubtedly Russia. During the first quarter of this year the machine tool exports of British production were valued at £816,103, an increase of £365,027 as compared with the same period of 1931. In one respect the new British action on imports has the effect of lowering the duty paid, for the Abnormal Importations Orders are revoked and the rate of 50 per cent is reduced to 20 per cent ad valorem. More detailed schedules are promised or proposed in which certain classes of machinery will be relieved completely. Thus particular consignments of machinery might be allowed to enter "under exceptional conditions." It has been suggested that power be given the customs commissioners to that end.

In general, on manufactured goods, the plan has been to add a duty of 10 per cent to the existing duty, making a total of 20 per cent. Where to the advisory committee a lower rate appears appropriate the total duty is 15 per cent, while for articles of luxury or semi-luxury character the total duty is 25 per cent or 30 per cent. It must not be thought that because a duty even higher, namely, 33 1-3 per cent, has been applied to them, ball bearings are regarded as luxury articles: the extra rate here imposed has no better basis than convenience of administration, 33 1-3 per cent being the present duty on imported motor vehicles as imposed a number of years ago.

Machine Tool Orders Up Slightly in April

Demand for machine tools is still down in keeping with business in general, reports the National Machine Tool Builders' Association. Some few orders keep coming through, but the volume is not enough to be encouraging. In the current demoralized business situation, when industries close to the consumer are operating at only 60 to 70 per cent of their ordinary capacity, there is bound to be relatively little call for replacements of old machines except for special purpose.

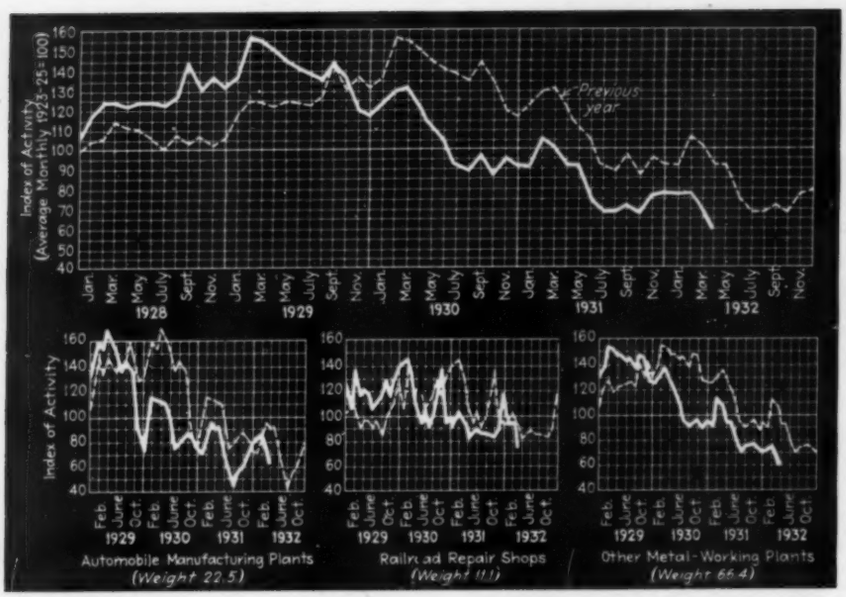
The renewed activity in the automotive industries has brought out a few orders for new tools. Sporadic activity in other industries yields an order here and there for cost-reducing equipment. But in the main, machine tool demand waits upon the quickening of business in general, and right now business in general is in a sad state.

The N.M.T.B.A. report on gross orders for the month of April does, however, show an increase over March. The April figure for all classes of machine tools is 41.1 as compared with 32.6 for March, 37.6 for February, and 59.1 for January. The three-month average, because of the dullness in March and February, is down to 37.1.

Orders for large and medium-size machine tools increased during April, their indexes rising from 32.0 to 40.6 and from 33.1 to 42.8 respectively. Tools in the smaller sizes underwent a slight decline in demand. The April figure for this class was 39.6 as compared with the March figure of 40.9. Unfilled orders in all three classifications show increases.

Auto Output Up

The National Automobile Chamber of Commerce reports motor vehicle production by American manufacturers in April at 146,584 units, an increase of 15 per cent over the preceding month, but 58 per cent below April last year. So far this year, according to the estimate, motor production is 51 per cent below that of 1931. The chamber's figures are based on reports of factory shipments.


Index of Activity (Average Monthly 1923-25=100)
Previous year
Jan. Mar. May July Sept. Nov.
1928 1929 1930 1931 1932
Index of Activity
Feb. June Oct.
1929 1930 1931 1932
Automobile Manufacturing Plants (Weight 22.5)
Railroad Repair Shops (Weight 11.1)
Other Metal-Working Plants (Weight 66.4)

April Metal-Working Activity Off Five Points from March

CONSUMPTION of electrical energy for power purposes showed metal-working activity slightly more than 5 points below the figure for March. Following a slight increase in energy consumption in February there came a drop of 10 to 16 points in March. April brought the index down to 62.1 from 67.7 for the previous month, 79.2 for February, 77.6 for January, 77.8 in December, 75.6 in November, 69.4 in October and 71.2 in September. These figures are all adjusted for 26 working days, as are those which follow:

The automobile shop index dropped to 64.4 from 69.2 in March and 85.3 in February. In previous months it was: 83.6 in January, 78.1 in December, 65.5 in November, 67.4 in October, 53.7 in September. The railroad repair shop index again took a drop from 81.9 in March to 75.1 in April. Figures for the preceding months were: 92.6 in February, 91.5 in January, 118 in December, 94.9 in November, 84.5 in October and 84 in September. Ferrous and non-ferrous metal-working plants not included in the railroad and automobile groups had an April index of 59.1, off some 5 points from the March index of 64.8. In this group figures for the preceding months were: 74. 8 for February, 72.7 for January, 70.9 for December, 76 for November, 71 for October, and 75 for September.

When the figures are adjusted for seasonal variations, slight revisions occur. The railroad repair shop index drops to 72.7 and the general metal-working index falls to 57.6, while the automobile shop index dips sharply down to 53.9. This gives a total seasonally adjusted figure of 58.5 as compared with 62.1 for the unadjusted index. Railroad repair shop seasonally adjusted indexes were, in previous months: March, 78.5; February, 81.7; January, 86.5; December, 116; November, 90.1; and September, 87. Similar automobile shop indexes were: March, 60.4; February, 81.8; January, 98; December, 114.2; November, 78.1; October, 55.4; and September, 52. For other metal-working plants the adjusted figures for previous months were: March, 59.4; February, 67; January, 68.7; December, 73.2; November, 78.1; October, 72.5; and September, 76. Figures for the entire group were: March, 61.7; February, 72; January, 77.3; December, 87.2; November, 79.4; October, 70.1; and September, 79.1.

Safety Record

When a mill employee fell from a ladder and suffered bruises in an accident at the Anderson (Ind.) plant of American Steel & Wire Co., he broke what the company claims is a world's record in safety work. According to FRANK PULSE, chief safety engineer of the Chicago district of the company, the plant had operated six years and 34 days without a lost-time accident, a total of 5,054,000 man-hours.

Welding Expert In New Position

CHARLES A. MCCUNE, widely known welding expert, formerly research director of the American Chain Co., and more recently director of research of the Welding Engineering & Research Corp., has become vice-president and technical director of Industrial Publishing Co. Mr. McCune is past president of the American Welding Society and of the International Acetylene Association.

• BUSINESS • ITEMS

Continental Motor Co. has purchased assets and business of Divco Detroit Corp., organizing Continental-Divco, a wholly owned subsidiary to continue manufacture of trucks. Directors of the new company are: W. R. ANGELL, ROGER SHERMAN, F. F. BEALL, WALLACE ZWIENER, JOHN NICOL, and CRAIG KEITH.

Berkeley Malleable & Steel Castings Co. has constructed a building at 850 Ashby Ave., Berkeley, Calif., where it will manufacture a general line of malleable and steel castings weighing less than one ton. More than $10,000 has been invested in equipment and building. WAYNE SMITH and A. AUGUST SEAZAR are partners in the concern.

Wallace Clark & Co., consulting management engineers, have announced a change of address to 1745 Graybar Bldg., New York City.

Osborn Mfg. Co., Cleveland, Ohio, has added to its list of products a complete line of overhead materials handling equipment to be known as Osborn Tramrail Systems, which will be designed and built in the new Materials Handling division. FRANKLIN G. SMITH is president, J. B. FORKER, JR., sales manager, and R. W. HISEY, secretary in charge of production.

Alumaweld Co. of New York has announced the opening of a New York office at 79 Madison Ave. The office will carry a complete stock of Alumaweld products and will also maintain a technical department to help in working out applications of the product.

Lincoln Electric Co., Cleveland, Ohio, has announced the appointment of Great Northern Tool & Supply Co. as distributors for Lincoln products in Montana and Wyoming. Great Northern stores and shops are located in Billings and Kevin, Mont.; Cody and Casper, Wyo.

Jenkins Machinery Co., has been organized at Sheboygan Falls, Wis., to take over and continue the business of Jenkins Machine Co., maker of woodworking equipment.

Farval Corp., 3277 East 80th St., Cleveland, Ohio, has recently acquired the manufacturing and sales rights of Farval centralized system of lubrication. This equipment was formerly manufactured by Lubrication Devices, Inc., Battle Creek, Mich. Officials of the company include: HOWARD DINGLE, president; W. W. CLARK, vice-president; H. C. ROBINSON, treasurer, and A. C. BLAIR, secretary. A. J. JENNINGS, formerly vice-president of Lubrication Devices, Inc., is general sales manager of Farval Corp. Distribution of Farval equipment for the central industrial section of the country is being handled by

Dingle-Clark Co., with offices in Cleveland, Cincinnati, Pittsburgh and Philadelphia.

Corben Sport Plane Co., Peru, Ind., is moving its plant and offices to Madison, Wis., where it will occupy a plant near the Madison airport. LOUIS F. SCHOELKOPF is president and O. G. CORBEN vice-president and general manager.

Machine tools and equipment of Fales & Jenks Machine Co., 320 Dexter St., Pawtucket, R. I., will be sold at auction on the premises May 25-26. The following day, May 27, an auction sale will be held to dispose of machine tools and equipment of Woonsocket Machine & Press Co., 533 Second Ave., Woonsocket, R. I. JAMES H. HURLEY, 1041 Hospital Trust Bldg., Providence, R. I., is the auctioneer in both instances.

Chain Belt Co., Milwaukee, is completing installation of additional heat-treating equipment for production of an alloy metal under license from Industrial Furnace Corp., Buffalo. A laboratory has also been installed, and G. K. VIALL has been placed in charge of development of this new phase of the business.

Danly Machine Specialties, Inc., Chicago, Ill., has recently added a new and complete torch-cutting and welding department, equipped to cut and fabricate steel plate shapes and various welded steel plate units for outside concerns.

Equity receivers for Watson Mfg. Co. have been directed to continue the business pending efforts to sell the plant, which manufactures metal specialties. The court held insufficient a bid of $321,000 for the plant assets offered by Watson Holding Corp.

Lakeside Bronze Co. has been organized at Buffalo, N. Y., by J. F. SMITH to manufacture brass castings.

Greaves Machine Tool Co., Cincinnati, O., will build an addition to its plant at 2009 Eastern Ave., to cost $3,000. Contract has been awarded to Austin Co., Cleveland.

Borst Engineering Corp. will move its metal specialties plant from Buffalo to Angola, N. Y., about July 1.

Acme Machine Products Co. is moving its Kalamazoo, Mich., plant to Muncie, Ind., where it will be consolidated with the Muncie plant at Hoyt and Willard streets.

Morrison Stitcher Corp., Niagara Falls, manufacturer of wire stitching machinery and equipment, and its sales organization, J. L. Morrison Co., of the same city, have been merged with Harris-Seybold-Potter Co., Dayton, O. The Morrison plant in Niagara Falls will continue in production.

L. C. Smith & Corona Typewriters, Inc., has acquired the plant, equipment and merchandise of Vivid, Inc., Chicago, manufacturer and distributor of duplicating machines, equipment and supplies, according to an announcement by FOWLER MANNING, president of the former company. C. F. METZGER, of L. C. Smith & Corona, will head the Vivid division and former officers of Vivid, Inc., are retained in important capacities.

Gedge Roofing plant at Anderson, Ind., has been purchased by Carpenter Bros. and M. DAY of Anderson. Concern manufactures iron roofing tanks, auto radiators and sheet metal spouting for buildings.

Pollard Bros. Mfg. Co., maker of steel factory bench equipment, will move from the present address at 4034 N. Tripp Ave., to 4444 N. Knox Ave., Chicago, on June 1.

D. H. Skeen & Co., Chicago, has been appointed distributor in the Chicago district for welding fittings manufactured by Bonney Forge & Tool Works, Allentown, Pa.

Link Belt Co. and its subsidiary, H. W. Caldwell & Son Co., Chicago, have been consolidated. The Caldwell company was made a subsidiary of Link Belt in 1921. Recently George W. Moore Co. was also purchased and consolidated with Caldwell. The three now are integral.

Western Wire Products Co., St. Louis, maker of wire products, cotter pins, bed springs and specialties, is expanding into larger quarters.

E. H. JOHNSON, 1265 First National Bank Bldg., has been appointed receiver for Ferguson & Lange Foundry Co., Chicago, and bids have been solicited for the sal: of equipment, material and office fixtures. The company was established in 1896.

THE BUSINESS WEEK

May 18, 1932

Looking backward over the course of the basic business and financial indicators during the past two months, anyone not completely poisoned by the pervasive pessimism that has accompanied this depression must be somewhat impressed by the scattered signs suggesting that most of the destructive force of the decline may have spent itself, and that some sort of uncertain equilibrium is being slowly established at current levels . . . Although employment and retail trade appear still to be declining, activity in steel, building and other basic industries seems to have settled around an irreducible minimum . . . The precipitate downward movement of commodity prices has slackened, and in some instances ceased . . . The broad averages of security prices have been fairly steady for several weeks . . . All this has been accompanied by an impressive easing of money rates and of financial stringency and tension in domestic and foreign centers . . . Most striking of all is the slowly emerging evidence that the catastrophic contraction of credit in our Federal Reserve system has been checked . . . Open-marked operations of Reserve authorities have brought rapid repayment of member bank indebtedness, rising reserves and deposits and some expansion of loans and investments . . . These accomplishments are encouraging in spite of the doubts and difficulties that surround them and the slowness of response of business activity and public sentiment to them . . . The business community is in a stronger position to resist any further shocks to confidence and a sound basis has been established for further remedial measures more directly attacking the unemployment problem than those so far applied.

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Gear Manufacturers Elect E. W. Miller

At the sixteenth annual meeting of the American Gear Manufacturers Association, the following officers were elected for the ensuing year: President, E. W. Miller, Fellows Gear Shaper Co.; first vice-president, John Christensen, Cincinnati Gear Co.; second vice-president, A. A. Ross, General Electric Co.; treasurer, J. H. Jackson, Pittsburgh Gear & Machine Co.

After ten years of service with the association as its secretary, T. W. Owen resigned, and J. C. McQuiston, formerly of the advertising staff of Westinghouse Electric & Mfg. Co., was named to fill his place as secretary-manager. The association passed a resolution of thanks to Mr. Owen for his service.

Two technical papers were presented: "Design and Use of Worm Gear Hobs," by L. R. MAYO, Brown & Sharpe Mfg. Co., and "A New Light on the Strength of Gear Teeth," by A. B. Cox. For the subject matter of Mr. Mayo's presentation, see page 633 of this number.

Mr. Cox's paper discussed the Lewis equation and showed that it does not fully meet the needs of modern gear design. This method of strength computation does not take into consideration dynamic loads and integral tooth contact. In addition, present practice in gear cutting has made the Barth velocity factors obsolete.

The division of tooth load between two or more pairs of teeth is affected by nine variables which complicate the problem of strength calculation. Dur-

ing its period of contact, each tooth carries a load which varies from a maximum, when applied at the tip, to a minimum, when applied near the root. But in integral contact gearing, the teeth cannot be considered singly. In his analysis, Mr. Cox superimposes the variable load curves for the teeth in contact, showing graphically how the total load is divided among them. From the graphical addition of loads, strength factors, applicable to this type of gearing, are derived. In closing, Mr. Cox described the effect of tip relief and root fillets.

Other papers presented were: "Apprenticeship and Its Relation to the National Metal Trades Association," by Harold S. Falk, Falk Corporation; "The Gear Industry in North Carolina," by Richard Ferguson, Ferguson Gear Works; "Business Ethics as Affecting Gears," E. S. Sawtelle, Tool Steel Gear and Pinion Co.; "Low Pressure Selling," by J. Harper Jackson, Pittsburgh Gear and Machine Co.; and "Overhead Control as Part of Standard Costs," by H. N. Mathias, Westinghouse Electric & Mfg. Co.

E. W. Miller acted as chairman at the annual dinner and introduced the Hon. W. R. Hopkins former City Manager of Cleveland who spoke on "Government — Our Greatest Problem." Later the Association was addressed by J. C. McQuiston.

• PERSONALS •

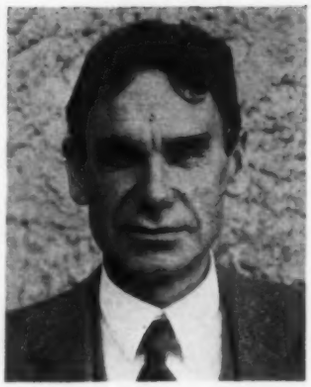
WALLACE CLARK, of Wallace Clark & Co., consulting management engineers, who has been abroad during much of the past three years, is in this country at his New York office, Graybar Bldg., until June 1.

GERARD SWOPE, president, General Electric Co., has been presented with the gold medal of the National Academy of Sciences in recognition of his constructive social services, particularly as regards unemployment.

HALVOR OLSEN HEM, consulting engineer, Toledo Scale Co., is the recipient of a John Price Wetherwill Medal of the Franklin Institute, "in consideration of the ingenuity shown in perfecting scales of the pendulum type, improving their accuracy, reliability and sensitiveness, and for the application of these scales to specific purposes."

ROBERT KLASS, expert on grinding, polishing and buffing, formerly with Hammond Machinery Builders, Kalamazoo, Mich., has joined the staff of the Machinery Division, Divine Brothers Co., Utica, N. Y.

Changes in the executive personnel of Allis-Chalmers Mfg. Co., Milwaukee, have been made as follows: GEN. OTTO H. FALK, president, has been made chairman of the board. MAX BABB succeeds him as president. W. A. THOMPSON and WILLIAM WATSON have become vice-presidents. R. DILL was chosen secretary and treasurer and J. A. KEOGH controller and assistant secretary. D. A. STEWART and A. F. ROLF are assistant treasurers, and H. W. STOREY is general attorney.



E. W. MILLER
Elected president of American Gear Manufacturers Association

The executive staff of Jeffrey Mfg. Co., Columbus, O., and its subsidiary, Ohio Malleable Iron Co., has been reduced from eight to six members. ROBERT W. GILLESPIE, president, becomes treasurer as well. J. F. DAVIDSON, former vice-president and assistant general manager, was named to the newly created position of assistant to the president. G. R. LUCAS, comptroller, is also made secretary. J. WALTER JEFFREY again becomes vice-president and NEIL E. SALSICH is vice-president and sales manager. HARRY SUPP, JR., former treasurer, and J. L. CONNORS, former assistant general manager, are still with the company in other positions. In the Malleable Iron company, JAMES M. KITTLE is made vice-president as well as assistant manager; GILBERT R. KITTLE was re-elected president; G. R. LUCAS is secretary, Mr. Gillispie treasurer, and J. WALTER JEFFREY vice-president.

F. H. DUTCHER has been nominated for chairman, Metropolitan Section, S.A.E., for the 1932-33 term. Other nominations are as follows: A. F. COLEMAN, vice-chairman; F. C. MOCK, vice-chairman for aeronautics; WILLIAM E. JOHN, vice-chairman for marine; C. H. BAXLEY, treasurer; and J. EDWARD SCHIPPER, secretary.

C. B. COLE, president, Tool Equipment Sales Co., was elected vice-president of Service Tool Die & Mfg. Co., 4625 Fulton St., Chicago. Other officers are as follows: CARL DANIELSON, president; CHRISTIAN SCHEEL, secretary; JOHN G. CROTSLEY, treasurer.

JUAN DE LA CIERVA, inventor of the autogiro, will be awarded the 1932 Daniel Guggenheim gold medal for outstanding work in the promotion of aeronautics, according to ALFRED D. FLINN, director of the Engineering Foundation.

J. R. BROWN has been appointed sales representative for Farrel-Birmingham Co., Inc., Ansonia, Conn., to handle the sale of press-brake and other types of mechanical and hydraulic metal-working presses in the Middle West territory. His headquarters are at the company's branch office, 2710 First Central Trust Bldg., Akron, Ohio.

O. V. BADGLEY and FRANK BURKE, both of General Motors, and DR. OLIVER WATTS, University of Wisconsin, were among the speakers at the second annual banquet of the American Electro-Platers Society, Grand Hotel, Anderson, Ind., May 7.

HARRY O. MCCULLY, formerly president, Erie Bolt & Nut Co., Erie, Pa., has been made general sales manager of Russel, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y. JAMES M. DILL, formerly manager of steel castings sales, Erie Forge Co., Erie, Pa., has resigned to become manager of sales for Erie Bolt & Nut Co., succeeding Mr. McCully.

WALTER HARNISCHFEGER, president, Harnischfeger Corp., Milwaukee, has been appointed official delegate of Milwaukee Association of Commerce to the executive session of the Chamber of Commerce of the United States at San Francisco, May 17-20.

H. J. RITTER, assistant secretary of Norma-Hoffmann Bearings Corp., Stamford, Conn., has been made sales manager of the organization.

GEORGE L. HURST, consulting mechanical engineer, 785 Market St., San Francisco, has been appointed by Farrel-Birmingham Co., Inc., 344 Vulcan St., Buffalo, N. Y., to handle the sale of gears, speed reducers, gear drives and gear cutting machines in the San Francisco territory.

CHARLES F. SCHERER, Davenport Machine & Foundry Co., Davenport, Iowa, will head the Quad-City Foundrymen's Assn. for the coming year.

• OBITUARIES •

W. E. BENSON, 52, an inventor of machinery, died recently at his residence, 625 Commonwealth Ave., Boston, Mass.

JAMES A. BOTSFORD, 70, treasurer, Pittsburgh Malleable Iron Co., Pittsburgh, died May 9 in that city. He had been with the company for 30 years.

CADY B. DURHAM, 58, former works manager, and subsequently vice-president, of Buick Motor Co., Flint, Mich., died May 10 in Miami, Fla.

JAMES D. CALLERY, a director of Union Switch & Signal Co., Swissvale, Pa., Westinghouse Air Brake Co., Wilmerding, Pa., and Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died recently in Pittsburgh.

FRANK W. DIEHL, 54, vice-president, Milwaukee Gear Co., Milwaukee, died

recently. He was for many years assistant superintendent of National Brake & Electric Co., Milwaukee.

JAMES DONNELLY, 59, for 12 years head of the rigging and assembling department, Durant motor plant at Elizabeth, N. J., died May 13.

HEINRICH KLEYER, 78, founder and director of Adler Machinery Works, Germany, died May 9 of influenza. He was well known in the United States.

ELMER O. LANGE, 36, production manager, South Side Malleable Casting Co., Milwaukee, until his retirement two years ago, died recently.

GEORGE MARSDEN, SR., 66, widely known industrialist of Beloit, Wis., died May 8 after a lengthy illness. He was at one time owner of Badger State Machine Co., part owner of Rock River Machine Co. and, in 1906, established P. F. Mork Foundry Co. and Hendley-Whittemore Co. He also founded Wisconsin Farm Implement Co. of Beloit.

HOWARD E. MAYNARD, 58, assistant chief engineer, Chrysler Corp., Detroit, died May 12. He had been connected successively with U. S. Motors Corp., Maxwell Motor Co., and Chalmers Motor Corp. before becoming connected with Chrysler.

CHARLES PFLITTNER, 48, formerly superintendent of Barton Axle Co., Barton, Wis., and a designer of automotive parts and units, died April 27.

ALAN C. RUSSELL, 40, assistant works manager, Remington Arms Co., Bridgeport, Conn., died May 5 at the Bridgeport Hospital.

ANDREW P. WESTON, 52, inspection manager, Pittsburgh Testing Laboratories, Pittsburgh, Pa., for 20 years, died recently in that city.

Rustless Steel Symposium, Exhibit

A non-technical discussion of the fundamental properties, the manufacture and fabrication, and the current uses and applications of commercial grades of rustless steel, with particular reference to their architectural adaptations will feature the program of the New York section, American Welding Society, at the final scheduled meeting, May 24, Engineering Societies Bldg., 33 W. 39th St., New York City. FRANK P. MCKIBBEN, newly elected president of the Society, will preside. J. H. CRITCHETT, vice-president, Union Carbide & Carbon Research Laboratories, Inc., will speak on "History, Classification and Metallurgy" of rustless steel, while C. A. SCHARSCHU, director of research, Allegheny Steel Co., and D. T. HADDOCK, consulting engineer, American Sheet & Tin Plate Co., will discuss "Available Types, Uses & Applications."

Aeronautic Meeting Set for June 6-8

The program of the National Aeronautic Meeting of the American Society of Mechanical Engineers at the Hotel Statler, Buffalo, N. Y., June 6-8, has been announced. It consists of the following sessions scheduled for Monday: Aerodynamics, Navigation, Metal Construction, Engines, Airship and Airplane Carriers, and Maintenance. In the session on Metal Construction which will be held in the afternoon, the following papers are scheduled for presentation: "Steel Airplane Construction," by E. J. W. RAGSDALE, research engineer, Edward G. Budd Mfg. Co., Philadelphia, Pa.; "Development in Aluminum Alloys in Relation to Economies in Aircraft Construction," by C. F. NAGEL, JR., technical director, U. S. Aluminum Co., Pittsburgh, Pa., and G. O. HOGLUND, aero. engr., Aircraft Development Aluminum Co., Pittsburgh, Pa.; "Evolution of Metal Construction," by GARDNER W. CARR, plant manager, Boeing Airplane Co., Seattle, Wash.; "A Comparative Study of Welded and Riveted Fuselages," by members of Philadelphia Aeronautic Society, presented by LOUIS C. ROSENSTEIN, president, and C. BENNETT, chairman of the committee; and "Monocoque Aircraft Construction in Theory and Practice," by RICHARD L. SCHLEICHER, structural engineer, American Airplane & Engine Corp., Farmingdale, L. I., N. Y. A report on wage incentive in the aeronautic industry will be made by W. T. TIFFIN, Curtiss Wright Co., chairman of a special committee making a study of this situation, at the Maintenance session in the evening.

Tuesday morning, June 7, will be devoted to a plant inspection trip to local aeronautic plants, including Irving Air Chute Co., Consolidated Aircraft Co., Hall-Aluminum Aircraft Corp. and Curtiss Aeroplane & Motor Co. In the afternoon there will be a session on Design, and one on Fuels & Engines. At a banquet in the evening, the Spirit of St. Louis Medal will be awarded to PAUL W. LITCHFIELD for his services in advancing airship design and construction in America.

Wednesday, June 8, will be devoted to a special all-day trip to Niagara Falls plants.

N.A.P.A. Convention Program Announced

The seventeenth annual international convention and Informashow of the National Association of Purchasing Agents will get under way at the Book Cadillac Hotel, Detroit, Mich., June 6, with two addresses, one on "Implications of Economic Planning," by WALLACE B. DONHAM, dean, Harvard University Graduate School of Business Administration, Boston, Mass., and another on "Relation of Research to Planning," by CHARLES F. KETTERING, vice-president, General Motors Corp., Detroit, Mich. DONALD G. CLARK, purchasing agent, Brown & Sharpe Mfg. Co., Providence, R. I., will speak on "Purchasing Problems as Affected by Economic Planning," E. C. ROBBINS, professor, Harvard University Graduate School of Business Administration, Boston, Mass., on "An Evaluation of Economic Planning, Particularly as it Affects the Work of the Purchasing Agent." Award of the J. Shipman Gold Medal will be made by JOHN R. WHITEHEAD, chairman of the committee on awards, and director of purchases and research, Fairbanks, Morse & Co., Chicago, Ill., in the evening.

• MEETINGS •

CHAMBER OF COMMERCE OF UNITED STATES
Annual meeting, Palace Hotel, San Francisco, May 17-20. D. A. Skinner, 1615 H St. N.W., Washington, D. C., secretary.

AMERICAN IRON AND STEEL INSTITUTE
Forty-first general meeting, Hotel Commodore, New York City, May 19. Howard H. Cook, secretary, 350 Fifth Ave., New York, N. Y.

NATIONAL ASS'N OF PURCHASING AGENTS
Seventeenth annual international convention and Informal Show, Book-Cadillac Hotel, Detroit, Mich., June 6, 7, 8, 9.

AMERICAN SOCIETY OF MECHANICAL ENG'RS
National Aeronautic and Process Meetings, Hotel Statler, Buffalo, N. Y., June 6-7-8.
Second National Applied Mechanics Meeting, Yale University, New Haven, Conn., June 23-24-25.
Semi-Annual Meeting, Bigwin, Canada, June 27-30.
National Machine Shop Practice Meeting, Buffalo. Week of Oct. 3. Calvin W. Rice, secretary, 29 W. 39th St., New York, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS
1932 summer meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., June 12-17. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENG'RS
Summer Convention, Cleveland, O. June 20-24. H. H. Henline, Assistant National Secretary, 33 W. 39th St., New York, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS
Annual meeting, Atlantic City, June, 20-24. R. E. Hess, assistant secretary, 1315 Spruce St., Philadelphia, Pa.

NATIONAL METAL CONGRESS & EXPOSITION
174th Regiment Armory, Buffalo, N. Y., Oct. 3-7. Sponsored by A.S.S.T., with cooperation of A.S.M.E., Institute of Metals and Iron & Steel Divisions of A.I.M.E., A.W.S., and the Wire Association. W. H. Eiseman, 7016 Euclid Ave., Cleveland, Director.

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Opportunities for Future Business

Ala., Montgomery — Montgomery Stove & Cooperage Co., plans reconstruction and re-equipment of plant at North McDonough St. Estimated cost to exceed $75,000.

Calif., Pasadena—Pasadena City Light Department, City Hall, completed plans for construction of a 63 x 221 ft. warehouse, 33 x 87 ft. carpenter shop and 33 x 89 ft. transformer repair shop. Estimated cost $125,000. Marston & Maybury, 25 South Euclid Ave., Archts. Work will be done by segregated contract under the supervision of Light Department.

Calif., San Diego—Ryan Aeronatical Co., Barnet St., awarded contract for construction of a 1 story, 100 x 120 ft. including shop at Lindergh Field. Estimated cost $20,000.

Calif., San Francisco—Electrical Products Corp., 950 30th St., Oakland, will not build factory building and office at 12th and Market Sts. here. $40,000. Postponed indefinitely. Noted March 3.

Calif., San Francisco—Goodyear Tire & Rubber Co., 6701 South Central Ave., Los Angeles, receiving bids for construction of a 2 story service building at 11th and Mission Sts. here. Estimated cost $40,000.

Calif., San Francisco—Q. R. S. Neon Corp., 306 7th St. awarded contract for construction of a 1 story factory for the manufacture of electric signs at 19th St. and Potrero Ave. Estimated cost $40,000.

Ga., Atlanta—City will lease additional space at Municipal airport for construction of a shop and overhaul plant by Eastern Air Transport.

Indiana — State Highway Commission, Indianapolis, will receive bids until June 1 for construction of garage buildings at Anderson, Bluffton and Auburn. J. J. Brown, Director.

Ia., Mapleton — Dotson Motor Co., having plans prepared for construction of a 1 story, 18 x 60 ft. repair and service garage on Fourth St. Private plans.

Kan., Chanute—State Highway Commission, G. T. Helvering, Dir., Topeka, awarded contract for construction of a division shops building at Garfield Ave. and 14th St. here. $16,000. Noted April 14.

Kan., Lawrence — Haskell Institute, c/o Department of Indian Affairs, Washington, D. C., having preliminary plans prepared for construction of a shop building here. $40,000.

Me., Westbrook—S. D. Warren Co., plans reconstruction of a paper manufacturing and storage building destroyed by fire. Estimated cost to exceed $100,000.

Md., Baltimore—Carriage & Toy Co., Pratt St., manufacturers of baby carriages, plans to rebuild warehouse and storage building destroyed by fire. Estimated cost $60,000.

Mass., Canton—Plymouth Rubber Co., manufacturers of rubberized cloth, plans construction of a 2 story warehouse and reclamation plant. Estimated cost $40,000.

Mass., Fall River—J. Donis, 1313 Highland Ave., having plans prepared for construction of a factory on Palmer St. Estimated cost $40,000 to $50,000. Architect not selected.

Mont., Great Falls—McCrea Fixture Co., Sixth St., manufacturers of store fixtures, etc., considering construction of 1 story, 80 x 150 ft. plant.

N. J., Fort Monmouth—Construction Quartermaster, will receive bids until May 31 for construction of fifteen garage buildings. Estimated cost $40,000. Private plans.

N. J., Newark—Seaboard Food Corp., leased building and will equip for garage and warehouse on Grafton Ave.

N. J., North Bergen—John Bock, c/o McDermott & Binda, 582 Bergenline Ave., Union City, having preliminary plans prepared for construction of a 1 story shop building. Estimated cost $40,000.

N. Y., Angola—Angola Board of Trade, having plans prepared for a 1 story plant. Estimated cost $40,000. Borst Engineering Co. Inc., 529 Colvin Ave., Buffalo, manufacturers of machines for making soap packets, products for vending machines, etc., lessee.

N. Y., Brooklyn—Belfan Building Corp., 26 Court St., plans construction of a 1 story, 50 x 100 ft. service garage and storage building at Jefferson St. and Wyckoff Ave. Private plans.

N. Y., Brooklyn—Casper Realty Corp., E. Iba., Pres., 6117 4th Ave., having plans prepared for a 1 story, 90 x 100 ft. service garage, etc., at 4th Ave. and 62nd St. Estimated cost to exceed $40,000. D. L. Lang, 1860 Broadway, Archt.

N. Y., Brook'lyn—New York Dock Co., 44 Whitehall St., New York, plans converting garage into manufacturing, distribution and storage building at Warren and Columbia Sts. here. $40,000. L. Birner & Sons, 45 Washington Ave., Brooklyn (hardware), lessee.

N. Y., Corona—J. D. Acctino and F. Lonardo, 92-02 50th Ave., Elmhurst, will build a 1 story, 30 x 60 ft. service and repair shop at 108th St. and 47th Ave. here. Work will be done by day labor and separate contracts under supervision of H. Sutters, 14-14 128th St., College Point, Archt.

N. Y., Garden City — Roosevelt Field Inc., Roosevelt Field, plans to rebuild hangar A destroyed by fire. Plans include shop, repair facilities, etc. Loss $50,000.

N. Y., Long Island City—Harold H. Anthony Inc., 31-59 12th St., will build a service building and garage at Vernon Blvd. and 31st Drive. V. Schiller, 30-64 41st St., Astoria, Archt. Work will be done by separate contracts. Maturity soon. Noted May 12.

N. Y., Long Island City—Peerless Weighing Machine Co., 245 5th Ave., New York, leased 16,500 ft. plant and will equip for shop and repair of weighing and vending machines at 43rd Ave. and 43rd Blvd. Some equipment purchased.

N. Y., Long Island City—Springfield Petroleum Co., 1772 Southern Blvd., Bronx., will build a 1 story, 20 x 97 ft. repair shop and service station at Merrick Road and Farmers Blvd. Work will be done by separate contracts. Noted May 12.

N. Y., New York—Joseph Lavazoli, 308 West 68th St., awarded contract for alterations to 2 and 3 story garage at 263 West 69th St. Estimated cost $40,000. Noted May 12.

N. Y., New York—Marks Bros. Holding Corp., M. Marks, Pres., 470 East 133rd St., will award contract about June 1 for a 2 story, 133 x 190 ft. service garage at St. Anns Ave. Boulevard to 132nd St. Estimated cost $100,000. J. J. Gloster, 303 West 42nd St., Archt. Noted April 28.

N. C., Dunn—J. W. Thornton Garage, plans construction of a service garage and storage building. Estimated cost to exceed $80,000. Maturity later.

O., Warren — Lang & Rodkey Inc., plan municipal airport expansion including construction of hangar, repair shop, etc.

Ore., Klamath Falls—Great Northern Railway Co., St. Paul, Minn., awarded contract for construction of a group of buildings, including roundhouse, machine shops, warehouse, quarters, etc. here. Estimated cost $100,000. J. R. W. Davis, St. Paul, Ch. Engr.

Ore., Woodburn — Ray Brown Canning Co., completed plans for extension of plant, part of which will be used as machine shop.

Tex., Fort Worth—City plans construction of an air terminal building including 2 story, 120 x 235 ft. hangar and administration building, etc. Estimated cost $150,000. American Airways, c/o C. R. Smith, Fort Worth, lessee.

Tex., Orange—Commercial Pulp & Paper Co., c/o S. M. Bump, Pres., plans extensions and improvements to plant including two buildings, 85 x 175 and 60 x 175 ft. to be used for recovery plant and wood room to increase capacity from 35 to 80 tons daily. Additional machinery will be purchased.

Man., Winnipeg—Fort Garry Motor Body & Paint Works Ltd., preparing plans for erection of a plant. Estimated cost $30,000.

N. S., Yarmouth—Meteghan Shipbuilding Co. Ltd., plans construction of a shipbuilding plant. Initial cost $50,000.

Ont., Kitchener—Wunder Furniture Co., 280 Victoria St., having plans prepared for construction of a furniture factory. Estimated cost $100,000.

Ont., Prescott — Newell Manufacturing Co. Ltd., King St., will soon award contract for addition and alterations to plant. Estimated cost $40,000.

Ont., Welland—American Manganese Steel Co., having plans prepared for erection of a plant. Estimated cost $500,000.

Equipment Wanted

Del., Wilmington—Board of Education. F. E. Booth, Bus. Mgr., Municipal Bldg., 10th and King Sts.—will receive bids until May 23 for equipment including shaper and router with tools, ¼ hp. electric, 110 a.c. r.t. Carter; center, lathe, spur for American Yates, No. 12-3 ph. a.c.; grinder, edge tool, elecrtic, Stanley No. 567-A.C.-110 v. 60 cycle; alundum grinding wheel, 10 in. diameter, 1¼ in. face ¼ diameter hole—30 grit; grade P; alundum grinding wheel, 10 diameter, 1¼ in. face ¼ in. diameter hole—60 grit grade O for high school.

D. C., Washington—Division of Purchase, Sales & Traffic, Department of Agriculture—will receive bids until May 20 for motor driven metal sawing machine. Pro. 1740; also until May 24 for band saw, jointer, portable keyseating machine, drum sander for Stoneville, Miss. Pro. 1739.

D. C., Washington — Office of Contracting Officer, Material Division, Air Corps, Wright Field, Dayton, O.—will receive bids until May 25 for 85 portable electric drills. Cir. 394.

D. C., Washington—Procurement Division, Veterans Adminstration—will receive bids until May 23 for grinder and portable sander during a 6 or 12 month period. Cir. 501-M and 535-M.

Alta., Calgary—Union Traction & Harvester Co. Ltd.—one large boring bar to take up to 7 in. cylinders.

Uruguay, Montevideo—Port Administration—will receive bids until July 11 for eight electrical cranes for semi-portal type.